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ABSTRACT

The study was directed toward developing a manual for establishing societal benefits and costs of vocational and manpower programs in Wisconsin. After first outlining the background of benefit-cost analysis, problems in establishing cost functions in education are presented along with some important cost concepts and uses of cost information in education. The next section deals with the identification and measurement of societal benefits of vocational programs. Five different methods of analyzing data related to societal costs and benefits of vocational and manpower programs are discussed in the last section. These methods are present value of net benefits, annual value of net benefits, rate of return, benefit-cost ratio, and pay back period. Procedural steps used and the advantages and disadvantages of each method are given. One of the major problems in establishing societal costs and benefits of vocational programs is the lack of relevant data, consequently, a need exists to develop a management information system for vocational, technical, and adult education. The report concludes that data required for the costs and benefits should be incorporated in a management information system. The required information for implementing various steps in establishing societal costs and benefits is outlined for curriculum, faculty, space, equipment, supplies, and administration. (MF)

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Conducted by

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Center for Vocational,
Technical and Adult Education
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Menomonie, Wisconsin

November, 1975

INFORMATION SYSTEM FOR SOCIETAL COST AND BENEFIT ANALYSIS OF VOCATIONAL AND MANPOWER PROGRAMS

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CHAPTER I

INTRODUCTION

The keyword in education for the seventies and perhaps the rest of the century may well be "accountability". Educators are discussing the exact meaning of this word from the implementation point of view.[1] In essence, the tax payers are asking educators to justify educational expenditures which currently rank next to defense expenditures in most countries. Education has been regarded as a par excellent good per se in the eyes of the public until recently. Educators are stirred by this new concept, as their sanctuary has never been encroached upon by the public in this fashion.

It would be wrong to assume that present standards of education were achieved without continued self-introspection and concern for improvement on the part of educators. Various schemes of certification of teachers, research on the effectiveness of various methods of teaching, exploration of new media and technologies, use of advisory committees, and similar activities were all employed to improve the process of education. However, these attempts at improving the process of education were usually piecemeal approaches which did not consider their impact on the total system of education and many times even disregarded the fiscal implications.

The new concept of accountability requires that the educators take a critical look at their system and remove inefficiencies in their resource

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[1] An issue of Phi Delta Kappan had eight articles on accountability, emphasizing the implementation aspect of it. Phi Delta Kappan, Volume LII, No. 4, December, 1970.

allocation and utilization. This approach requires a balanced emphasis on inputs and outputs of education by establishing relationships between the two so that alternatives of producing outputs with different mixes of inputs can be analyzed on a scale of cost-benefit or cost-effectiveness.[2]

Society is justifiably concerned as to how well its tax dollars are spent. There is no reason for educators to be irritated by this demand, as it will require them to review their processes. This may bring about further improvements for which the educators have always been so sincerely and devotedly concerned.

STATEMENT OF PROBLEM

There is a great need to develop uniform procedures for establishing cost and benefits of vocational and manpower programs. Wisconsin State Board of Vocational, Technical, and Adult Education (S.B.V.T.A.E.) is aware of this need. A few pilot studies regarding cost and benefits of selected post-secondary programs were initiated by S.B.V.T.A.E. in 1974. The pilot studies done in a few districts were very useful as they made the researchers aware of some of the problems and issues involved in such studies. The reports of the pilot studies indicated that the problems associated with establishing societal costs and benefits of vocational programs were more complex as compared to the private or governmental cost and benefits of the same programs. A need for standardizing

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[2]Cost-Benefit approach requires that both the outputs and inputs of education be priced in dollars to justify and evaluate various alternatives of producing outputs. Cost-effectiveness approach requires that only the educational inputs be priced in dollars in order to compare various mixes of inputs with outputs.

procedures in establishing societal cost and benefits of vocational and manpower programs was expressed by the researchers. It was felt that a manual for establishing societal cost and benefits of vocational programs in the State of Wisconsin will provide a framework for future on-going studies in different districts.

BACKGROUND OF PROBLEM

In 1961, McNamara and Hitch introduced the Planning, Programming Budgeting System (P.P.B.S.) approach in the Department of Defense.[3] The process of planning essentially constituted determining long and short range objectives and specifying alternative methods of achieving objectives. The programming process emphasized optimizing the mix of input resources to attain a specified set of objectives. The budgeting process implied a process of systematically relating the expenditure of funds to the accomplishment of objectives. This systematic approach improved considerably the overall decision-making processes in the Defense Department. The achievement was so impressive that President Johnson announced in 1965 that other departments of the federal government should gradually implement P.P.B.S. In 1966, the Committee for Economic Development urged Congress to adopt this new system. Again, in 1967, the President endorsed the system in his budget message to the Congress.

State and local governments were also generally receptive to

[3]For a detailed approach see David Novick, editor, Program Budgeting: Program Analysis and the Federal Budget, Harvard University Press, 1965, especially chapters 2 and 3.

P.P.B.S. Wisconsin adopted the system in 1963. Governor Rockefeller's administration installed it in New York. Jesse Unruh, former speaker of the California Assembly, summed up the need for a P.P.B.S. approach at all levels:

> In my judgment, well informed legislators, governors and administrators will no longer be content to know, in mere dollar terms what constitutes the abstract needs of the schools. California educators have used this tactic with our legislatures for many years with constantly diminishing success. The politician of today, at least in my state, is unimpressed with continuing requests for more input without some concurrent idea of the school's output.[4]

Educational administrators are slowly accepting P.P.B.S. Hartley identified ten representative school districts in various parts of the country which are implementing this system.[5]

Education has recently been affected by federal and state cuts in public spending due to a drive to fight inflation or meet the needs of other competing social sectors. Most educational institutions throughout the nation are feeling the impact of these cuts. The taxpayers are becoming more resistant to increased taxes.[6] President Nixon in his March, 1970, message on educational reforms said, "We have as a nation too long avoided thinking of the productivity of schools."

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[4]See Joseph H. McGivney and William C. Nelson, "Program, Planning, Budgeting Systems for Educators, Vol. I - An Instructional Outline." Center for Vocational & Technical Education, The Ohio State University, Ohio, August, 1969, p. 7.

[5]Harry J. Hartley, "Educational Planning, Programming Budgeting: A Systems Approach". Prentice-Hall, 1968. The districts mentioned are: Baltimore, Chicago, Dade County, Los Angeles, Memphis, New York, Philadelphia, Sacramento, Seattle, and Westchester County in New York State.

[6]See Jean M. Flanginan, "Is There A Taxpayers' Revolt?", Phi Delta Kappan, October, 1969, pp. 88-91

The accountability concept goes much beyond P.P.B.S. in trying to emphasize or relate the effectiveness of education programs to money expended. It also emphasizes an objective educational audit, which has not been conducted in the school systems since their inception. Educators have responded to these demands by taking a second look at their process of planning from a systems point of view. The curriculums are being scrutinized in response to the current needs of the society. The utilization of the input resources are being evaluated with a concern to improve productivity. The scope of analytic techniques used in improving, planning and effectively managing the system is being examined.

Another dimension of educational accountability requires that advance information about the costs and benefits of educational programs be provided to prospective students to enable them to make informed decisions relative to their training program choices, and thus their future occupations and primary source of income.

HISTORICAL BACKGROUND OF BENEFIT-COST ANALYSIS

'Benefit-cost' analysis is by no means a new procedure. Plato in The Republic recognized general social benefits by investing in the education of prospective state rulers. Haveman indicated that in 1936, Congress established benefit-cost analysis as a formal requirement for authorizing flood control projects.[7] The systematic studies of benefit-cost of educational programs preceded from Becker's and Schultz's concept of investing

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[7]Robert H. Haveman, 'Water Resource Investment and the Public Interest.' Nashville: Vanderbilt University Press, 1965. pp. 22

in human capital through education.[8] There are hundreds of studies, papers, reports, and monographs which have attempted to evaluate educational and manpower training programs in terms of their benefits-costs.[9] However, relatively few studies exist which have attempted to standardize the procedures for establishing benefits and costs of educational programs. As a result, different researchers have used different procedures for establishing benefits-costs of educational and manpower programs. Sometimes the same researcher used different techniques for different research projects.[10] Differences in concepts and methods limit the comparability of benefits-costs of various programs. Thus, there is a need to develop a manual for establishing benefits-costs of vocational and technical programs in Wisconsin.

ROLE OF BENEFIT-COST ANALYSIS IN THE CONTEXT OF BACKGROUND

The information regarding benefits and costs of education could be deployed for various purposes in education. A brief description of some of the uses follows.

1. Resource Allocation Decisions

A basic premise of economics is that at any given time there are limited means and almost unlimited needs or wants.

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[8]For an excellent collection of readings See M. Blaug (ed.) 'Economics of Education'. Vol. 1 & Vol. 2, Baltimore, Maryland: Penguin Books Inc., 1968 and 1969

[9]For an excellent review and synthesis of benefit-cost studies, see Ernst W. Stromsdorfer, 'Review and Synthesis of Cost-Effectiveness Studies of Vocational and Technical Education'. Columbus, Ohio, The Center For Vocational and Technical Education, The Ohio State University, August 1972.

[10]See Einar Hardin, 'Benefit-Cost Analysis of Occupational Training Programs: A comparison of Recent Studies' in G.G. Somers and W.D. Wood 'Cost-Benefit Analysis of Manpower Policies: Proceedings of a North American Conference'. Kingston, Ontario, Industrial Relations Center, Queen's University. 1969. pp. 97-118

Economists, therefore, are primarily concerned with the problem of allocation of scarce resources to unlimited ends. Based on this premise, it may be said that education competes for scarce resources with other social sectors. Within the educational sector itself, there could be competition among various types of education for scarce resources; for example, vocational education might be competing with elementary, secondary, and higher education. This basic principle of resource allocation problems can be extended to state, district, and institutional levels for various types of education, as well as a particular type of education. Resource allocation decisions may perhaps be made more rationally through the knowledge of benefits and costs of education and relating them to specific objective functions of the decision makers like educators, administrators, at the district and state levels and the members of the legislature. The information regarding benefits and costs can help a decision-maker assign weights to various objectives, which in turn may help in decisions regarding allocations of scarce resources toward achieving various objectives of various decision makers at different time periods.

The funding decisions regarding vocational education in the State of Wisconsin are taken at the district, state, legislature, and governor's levels. As funding decisions move towards the state level, it becomes increasingly important for district level educational administrators to make informed recommendations and decisions regarding educational appropriations. The present fiscal and budgeting systems do not require adequate information on education programs benefits nor on program costs. This

vital information would help considerably district and state level administrators in making valid and appropriate decisions and recommendations to the legislatures in allocating funds to the various educational programs located in various districts and other competing social services like highways, health-care, welfare, etc.

2. Program Planning

Planning of any educational program requires an identification of various objectives and activities or services required to achieve pre-specified objectives. Theoretically, there may be an infinite number of ways in which these activities or services can be mixed. Some of the alternative mixes of activities may be ruled out due to such constraints as availability of right types of physical input resources, including money or budgets, time and technology. Other constraints of social, political, and legal nature might weed out a few more alternatives, leaving a few to be considered as competing candidates for an educational program.

The concept of "Accountability" requires educators to investigate various technically feasible alternatives to achieve predetermined objectives and employ the most efficient one. A most efficient alternative may be defined as that alternative which produces the most per taxpayer dollar. The adjective "most" associated with educational production may include both quantitative and qualitative measures of outputs of education. Benefits and cost information regarding various alternatives, therefore, may help in the choice of the optimal alternative. Since the outputs of education are multiple in nature, weights may be assigned to

various outputs or objectives of education and a single index in terms of utility of education of various alternatives used for the purpose of choosing the most efficient, technically feasible alternative.

The benefits and costs of various alternatives for vocational programs will help in evaluating the economic efficiency of various alternatives. Some of the alternatives for a vocational program may be a regular day program, part-time evening program, on-the-job or apprenticeship program, etc. Such an evaluation will help vocational education administrators at the district and state levels to decide about the most effective alternative, or the optimal mix of alternatives for a vocational program.

3. Program Evaluation

Program evaluation may be defined as a procedure to verify the extent to which the objectives of education were achieved as related the actual cost incurred. The underlying objective of program evaluation may be to analyze the deviations of achievement of objectives and actual costs with the planned objectives and costs. The motivational force beyond this objective could be to further improve the educational system by comparing the performance of various programs within an institution, or the performance of a program among a set of similar institutions.

Three basic approaches have been used for the purpose of program performance, namely, cost-benefits, cost effectiveness, and the

rate of return approaches. All these approaches require data on actual benefits and costs of educational programs. A brief description of these approaches follows.

The cost-benefit approach attempts to price both the inputs and outputs of education in dollars. The inputs of education priced in dollars represent the costs of education and the outputs priced in dollars represent the benefits of education. A benefit-cost ratio could be computed from the benefits and costs of education in dollars. A ratio greater than one implies that for every dollar invested in education, more than a dollar was being received back. A ratio equal to one means that a dollar was being received for every dollar invested in education. A ratio less than one may be interpreted as a return of less than a dollar for a dollar invested in education. Cost-benefit ratios could be computed for various programs within an institution, or for a program offered at various institutions. Such ratios may help in evaluating the outcomes of various programs and also facilitate in decisions regarding resource allocations among various programs.

A cost effectiveness approach prices the inputs of education only and the cost of education so calculated is related to the effectiveness of educational programs which might be spelled out apriori in terms of the behavioral objectives of the educational programs. Since the objectives of education are multiple in nature, a single index of objectives in terms of utility may be derived by assigning weights to various objectives. Effectiveness-

cost ratios can be computed to make an interprogram comparison of a program. Such effectiveness cost ratios may help in the post-audit of the outcomes of various programs and also stimulate further improvements of various programs.

A rate of return approach is a procedural modification of cost-benefit approach. Instead of computing benefit-cost ratios, an attempt is made to find the rate of return or the specific interest rate at which the net value of benefits are equal to zero. The net value of benefits may be defined as the difference between the benefits and costs in dollars, both discounted at the unknown interest rate. Rate of returns of various programs at an institution or a program at various institutions may help in evaluating the feasibility of investing money in education and also in resource allocation decisions between education and other social programs, or among various programs in an educational system.

The three approaches to program evaluation have limitations of their own. A brief description of these approaches was given, as one common aspect of all above mentioned three approaches is to determine the costs of education. The methodology of costing inputs, therefore, may help in implementing any or all of the above approaches which can be used for program evaluation.

4. Program Formulation

Information on costs of education can help educators and legislators in formulating more sound educational policies. For example, policy decisions regarding expanding or phasing out existing

educational programs or introducing new educational programs may require information regarding the fiscal implications of such policy decisions. The monetary consequences of such policy decisions, along with other relevant information such as long and short term manpower needs of the economy and/or social demand for education, may help in further improving such policy decisions.

Most educational institutions at present are experiencing financial crises. This may require educators and legislators to take a hard look at such policies as class size, faculty load, school size, mergers of various vocational schools within a district for the purpose of a centralized administration and purchasing, consolidation of various school districts to reduce the number of school districts, encouraging independent studies and programmed instruction and so on. The fiscal implications of such policies may help in improving the formulation of sounder policies. However, it should not be implied that sounder policies should be solely based on cost consideration alone. Other pertinent factors such as benefits or effectiveness of various educational programs should be given due consideration.

5. Economies of Scale

The information regarding costs of education may be established to study the economies of scale in education. The term economy of scale is referred to as a relationship between the costs and size of the institute or class. It may be emphasized that economies of scale do exist in education. The economies of scale

might not have been exploited due to a relatively rigid structure and technology of education. There may be a great deal of potential if one were to exploit these economies without sacrificing the quality of education. Use of cost information for studying economies of scale should, therefore, be encouraged.

6. Budgeting

The use of cost functions for the purpose of budgeting has a long historical background. Such cost functions in due course of time took the form of budgetary formulas. Those budgetary formulas may have the common objective of predicting future costs for the purpose of budgeting, yet the basis of the various formulas for the same purpose in a set of similar institutions may be so different that one might even question the validity of these formulas. Some of these formulas may have been formulated as a rule of thumb rather than derived from the cost functions. Even where the cost formulas were derived from the cost functions, the functions themselves might not have been updated to reflect the charge in the cost structure of the educational system.

At present, the state funding formula for vocational education programs in Wisconsin bears little relation to the actual program costs. Since vocational education programs costs vary among various programs for the same unit of time, there is a need to link program benefits with program costs in order to come up with an effective funding formula. It is felt that future funding should be related to the actual program costs.

7. Decision Making

The information regarding benefits and costs in education may help improve the decision making process. The process of decision making can be distinguished from the policy making process, the former having short range implications in the control of day to day operations and the latter having long range implications in the formulation of planning policies. An example of decisions of this type may be equipment replacement decisions. The cost information regarding repairs, maintenance, the market value of the existing and new equipment from time to time and other related cost and benefit or effectiveness information can help in making better replacement decisions.

8. Management Information System

There is a great need to develop a uniform management information system for the vocational education system with an emphasis upon outputs of the system. Such an information system should be designed to facilitate vocational education administration in programming, planning, budgeting, policy formulation, and decision making. Standardized procedures for establishing benefits and costs of various vocational programs will help achieve this purpose to some extent.

Summarizing, the benefits and costs information of education may have a multiplicity of uses. These uses can be broadly categorized into planning, programming, budgeting, decisions and policy making.

These areas overlap each other. Analysis of benefits and costs information in these areas can help in further improving the educational system.

DIFFERENCE BETWEEN BENEFIT-COST AND EFFECTIVENESS-COST STUDIES

A brief mention of the three approaches to program evaluation was made earlier. These approaches included benefit-cost ratios, effectiveness-cost ratios, and rate of return. It may be helpful to further elaborate the distinction between benefit-cost, and effectiveness-cost or sometimes also referred to as utility-cost analysis. In benefit-cost studies, both the benefits and costs are measured in dollars. Effectiveness-cost studies measure the effectiveness of a program in terms of its objectives (both monetary and non-monetary) and relate it to the costs in dollars. Utility-cost studies convert the objectives of a program (both monetary and non-monetary) in terms of a single index called 'utility' of the program and relate it to the dollar costs. Again, benefit-cost, effectiveness-cost, and utility-cost studies may be private, governmental, or societal depending on the viewpoint from which such studies are undertaken.

Benefit-cost analysis is much more common than effectiveness-cost analysis for two reasons. First, economists had a substantial influence on the development of such studies and their main concern has been the efficiency in the use of resources. The most direct way of measuring the efficiency of a program is to measure the dollar value of outputs against the dollar value of inputs. A program is efficient economically if the dollar value of outputs is equal to or greater than the dollar

value of inputs. The second reason for the popularity of benefit-cost studies versus effectiveness-cost studies is that the universally agreed upon measures of effectiveness or objectives of a program are very seldom available. Values determined for various measures of effectiveness are often determined arbitrarily by the study analysts. The process of assigning weights to convert various measures of effectiveness into a utility index is also determined arbitrarily.

The emphasis on the economic consequences in benefit-cost studies of educational and manpower programs as opposed to, social consequences has been criticized frequently. However valid and justified these criticisms may be, they do not invalidate benefit-cost studies for three reasons. First, many benefit-cost studies do concern themselves with non-economic aspects of educational and manpower programs. Although these aspects are not integrated in benefit-cost calculations, yet they are indicated separately. Second, education and manpower programs alone are not the only source of such non-economic benefits (good citizenship, appreciation of arts and culture). The community, family, or social environments may be responsible for developing such non-economic benefits. Third, when an attempt is made to list the main goals of vocational education and manpower programs, these are usually mentioned as getting entry-level jobs for the program participants, or enable them to retain or advance on the jobs. The economic consequences of increased employment are measured through increased income. The other non-economic goals of vocational education and manpower programs are considered as secondary goals.

THREE TYPES OF BENEFIT-COST STUDIES

Benefit-cost studies are generally categorized into three broad categories listed below:

A. Private benefit-cost analysis

B. Governmental benefit analysis

C. Societal benefit-cost analysis

The private benefit-cost studies are aimed at establishing the benefits and costs to the students. The benefits of a vocational program are assumed to accrue to the individual participants of a program. Such benefits include incremental or additional earning, net of taxes, job satisfaction, chances for advancement on the job, opportunities for getting further education, and so on. The costs are assumed to be incurred by the students and include such factors as tuition and other related educational expenses on books, supplies, etc; the foregone net income of taxes due to a student being in school rather than working on a job; and the incremental or additional expenses of lodging and boarding are some examples.

The governmental benefit-cost studies of vocational programs are based on the premises that the benefits and costs accrue to the government. The benefits to the government of a vocational training program include: incremental or additional taxes paid by the students after graduation as a result of incremental earning due to vocational education; reduction in transfer payment, including welfare, food stamps, unemployment compensation, etc., as a result of a student becoming ineligible for such payment due to vocational training leading to his employment.

The societal benefit-cost studies assume that society is the recipient of both the benefits and costs of the vocational programs. Societal benefits include such things as the incremental gross national product, gross of taxes, as a result of vocational training leading to job satisfaction; increased productivity of other capital resources of society; equitable distribution of national wealth; reduced crime rate; and better citizens. Societal costs include opportunity cost of operating the vocational schools including the capital costs; and the reduction in gross national product due to program participants displacing employed workers.

It may be seen that the private, governmental, and societal benefit-cost studies attempt to establish benefits and costs of vocational programs from different viewpoints and that benefit and cost elements in these studies are not identical. A distinction between different categories of benefit-cost studies helps in resolving one of the issues in benefit-cost studies, namely, what benefits and costs should be included. Obviously, the answer depends on whose benefits and costs are beirg established.

SCOPE OF STUDY

This study is primarily directed towards developing a manual for establishing societal benefits and costs of vocational education programs in Wisconsin. Such a manual is mainly directed towards research directors in vocational and technical institutes in Wisconsin due to their being responsible for gathering and analyzing information regarding benefits and costs of vocational programs. It is felt that this manual

could also be used by directors of institutional research of various colleges and universities in Wisconsin. The specific objectives of this study are given below:

1. To identify societal benefits of vocational programs.
2. To develop direct or proxy measures of societal benefits of vocational education programs.
3. To develop procedures for measuring identified societal benefits with direct or proxy measures.
4. To identify societal costs of vocational programs.
5. To develop direct or proxy measures of societal costs of vocational education programs.

LIMITATIONS OF THE STUDY

This study is limited to establishing a manual for societal benefits and costs of the vocational programs. It may be emphasized that private and governmental benefits and costs are excluded from the scope of this study. Although the benefits and costs to the students, governments (local, state, and federal), and society of various vocational programs differ, the basic methodological procedures laid down in this manual could be applied to private and governmental benefit-cost ratios of various vocational programs.

The study is also limited to establishing societal benefit-cost ratios of vocational programs rather than effectiveness cost ratios. This was necessitated due to the fact that the societal non-monetary goals or out puts of various vocational programs are not only diverse but also change with time. Further, it is not possible to measure such

non-monetary goals without decision-makers mutually agreed upon measuring instruments. However, an attempt has been made to develop monetary proxy measures of non-monetary goals or outputs whenever it was feasible to do so. The basic procedure for establishing societal benefit-cost ratio of a vocational program could also be deployed with some modifications for establishing effectiveness-cost ratios of vocational and manpower programs.

CHAPTER II

SOCIETAL COSTS OF VOCATIONAL EDUCATION PROGRAMS

INTRODUCTION

The cost information in education has a multiplicity of application, as was discussed earlier in Chapter I, in the context of the role of benefit-cost studies of education and manpower programs. Some of the important uses of cost information discussed included resource allocation decisions, program planning and evaluation, policy and decision making, budgeting, and the study of the economies of scale in education. The analysis of cost information in education may help in improving the educational system.

The analysis of cost-information may require some familiarity with basic concepts and terminology such as fixed and variable costs, direct and indirect costs, total and average costs, marginal and incremental costs, opportunity and shadow costs, capital and recurring costs, joint and sunk costs, private and social costs. The description of these cost concepts was restricted to a bare minimum to save space. Each of these concepts has been illustrated with educational examples. The implications of these cost concepts on education have also been discussed very briefly.

After building some background in cost concepts, a general procedure for establishing societal costs of vocational education programs has been discussed. This procedure has been primarily designed for unit cost studies which aim at finding the societal costs per graduate by program. This procedure has been primarily designed for unit cost studies which aim at finding the societal costs per graduate by program. This procedure is more or less based on the "standard costs" concept used in business and industry which may be designed for finding the average costs.

The cost information has multiple uses besides unit cost studies. A generalized procedure for handling cost information related problems

has been discussed very briefly. The procedures for unit cost study and cost information related problems would reveal that these procedures are relatively easy to implement in a variety of situations. There are, however, some problems and issues which haunt cost analysts in almost any situation, including business and industry. A brief discussion of some of the problems has been given.

Perhaps a distinction should be made between costing and cost functions of education. Whereas costing is more or less based on ex-post cost data, cost functions are based on ex-ante cost-output relationships. Cost functions of education, if properly established, may help project costs in the future.

A. BASIC COST CONCEPTS AND TERMINOLOGY

Familiarity with some basic cost concepts and terminology is important for the purpose of analyzing educational costs. The cost concepts discussed in this section are so basic in the costing literature, that a skeleton description of these concepts has been given with a special reference to their application in an educational system.

1. Fixed and Variable Costs

Fixed costs are those which do not relate to the number of students over a short range of time. For example, the cost of a school principal or director of a vocational institute would be independent of the number of students, and also, would remain the same over a short range of time.

Variable costs are those costs which vary directly with the number of students. For example, the supplies used in a laboratory course would vary directly with the number of students, and as such are classified as variable costs of education.

The implications of the fixed and variable costs in education could be that at a specified period of time the greater the fixed costs in education,

the more the potential to reap economies of existing scale; as the fixed costs, by their very nature, do not change over a short period of time with an increase in the number of students, thereby reducing the average cost per student. It may, however, be pointed out, that in the long run the fixed costs may also change. The short run may be defined as a period which is long enough to permit any desired change of output technologically feasible without altering the scale of plant, but which is not long enough to permit any adjustment to the scale of plant.

2. Direct and Indirect Costs

Direct costs may be defined as those costs which are directly related to an activity or service. For example, the direct cost of instruction may include the cost of the faculty, space, equipment and supplies.

Indirect costs may be defined as those costs which are indirectly related to support an activity or service. For example, the indirect cost of instruction may include the costs of such supporting services as library and audio-visual equipment.

The terms "direct" and "indirect" may sometimes lead to ambiguities. For example, the cost of a guidance program, in so far as it helped in the selection of courses, may be treated as a supporting service to instruction, and as such treated, as an indirect cost. The guidance service may also be treated as a service having an entity of its own, and as such treated, as a direct cost.

The concept of direct and indirect costs in education could have implications on such policy decisions as they relate to the extent of activities or services that should be provided to support the main activities or services of the educational system.

3. Total and Average Costs

Total costs may be defined as those costs which include both the fixed and variable costs for the entire educational system. Average costs may be defined as the cost of producing one unit of output and may be computed by dividing the total costs by the number of output units produced. For example, in the case of education, the average cost could be expressed as a cost per graduate, or a cost per credit or contact hour, or cost per daily attendance. The average costs may be computed by programs or levels of students.

Average costs may be further categorized as average fixed and average variable costs. These costs can be computed by dividing the total fixed or total variable costs by the number of output units produced and will respectively give average fixed and average variable cost per unit of output.

Average costs for prediction purposes should be used only when the educational system under study has assumed normal or steady state. For example, an educational program which has been started recently is more likely to have high average costs. On the other hand, an old educational program which had established itself and as such had optimal or near optimal enrollment, is most likely to have low average costs. Average costs can also be computed by fixing upper and lower bounds with different measures of dispersion like standard deviation.

The implications of the total and average costs of education could be that these may reflect trends in the educational system which may serve as a proxy measure of the efficiency or the productivity of the educational system. A comparison of the average costs of the same programs at various institutions may stimulate interest in analyzing the

structure of education to promote efficiency, perhaps without its having adverse effects on the quality of the education.

4. Marginal and Incremental Costs

Marginal cost may be defined as the cost of producing a marginal or an additional unit of output. For example, the cost of producing an additional student, over and above the present number of students in an educational program, will give the marginal cost of the program. The marginal cost of the program so computed may or may not be equal to the average cost of that program. In some cases, the marginal cost of an educational program may be very insignificant if the additional or the marginal unit utilized idle input resources. For example, if an additional student in an educational program does not create demand for any extra input resources, assuming that he would select classes which had below optimal enrollment, the marginal cost of producing this student may be the cost of supplies only which were used in his education. Marginal costs of education can become a very useful and important tool in deciding admission policies at a time when education faces financial crises.

Incremental costs may be defined as the differential costs of expanding or contracting units of outputs. The difference between marginal and incremental costs is that whereas the former deals with one additional unit of output at a time, the later may be dealing with more than one unit of output at a time. The incremental cost concept can, therefore, be very useful in estimating the financial implications of expanding or contracting existing programs or introducing new programs. The incremental cost of expanding or contracting existing programs should not be computed by multiplying the average costs of such programs by the number of students to be increased or decreased in an educational program.

The extra costs or savings should be computed by costing the extra inputs required or saved as a result of expansion or contraction of such a program. Incremental cost is sometimes also referred to as out-of-pocket cost and can be a powerful tool for certain other educational decisions and policies.

3. Opportunity Costs and Shadow Costs

Opportunity costs may be defined as the potential return from the next best available alternative use of a resource input. For example, the opportunity cost to the students for attending an educational institute may be equivalent to the income which he would be receiving if he were employed elsewhere. Similarly the opportunity cost of an educational resource input like building is the next best available alternative which uses this building. Therefore, the concept of opportunity costs in education could help in better resource allocation decisions.

The concept of shadow cost may be defined as the differential in the output of education, if an additional unit of educational input were available. For example, the shadow cost of a teacher will be the increased output of education if another teacher were available. The concept of shadow costs may help in maximizing problems in education.

6. Capital and Recurring Costs

Capital cost may be defined as an investment in long term capital goods, e.g., building and grounds. Recurring costs may be defined as costs which recur over a short period of time, such as salaries of faculty members, expenses for buildings and ground maintenance. The definitions of long and short period of time are mostly done on an arbitrary basis.

Capital costs may have implications for costing educational programs. Since capital costs are incurred on capital goods which last for a long

period, it may be appropriate to prorate these costs over the instructional life of capital assets in order to arrive at the true cost of an educational program. The procedure to prorate capital costs over their instructional life is discussed subsequently under generalized procedures for costing inputs of education.

7. Joint Costs

Joint costs may be defined as those costs which are borne for the production of joint outputs, goods, or services. For example, the costs of the central administration may be classified as joint costs, as these costs are incurred to support instructional and non-instructional services.

The joint costs may pose the problem of allocating such costs among various outputs or services in order to arrive at cost per unit output. There may be several bases of allocating joint costs. For example, the costs of central administration may be allocated among several educational programs, based on the number of students in various programs or on the number of faculty members serving these programs. What would be the best procedure? How sensitive would the results be by using an alternative basis? What would be the cost of collecting information for using a certain basis? These are very hard questions to answer, but nevertheless have been discussed under generalized procedures for costing inputs of education.

8. Sunk Costs

Sunk costs may be defined as costs or investments which were made in the past; for example, investments in the existing buildings may be referred to as a sunk cost. The concept of sunk cost in education may be important in certain educational decision problems. According to the economists, sunk costs should not interfere with future decisions.

For example, if it was discovered that a recent large investment in a computer for an educational institute was wrongly made by picking up an inappropriate piece of equipment, the decision regarding the purchase of the right type of equipment should ignore the recent past investment or the sunk cost. The decision in this case perhaps should be made by taking into consideration the incremental costs and benefits or effectiveness of various available feasible alternatives. The concept of sunk cost may be applied to faculty as well due to the tenure system in education. If an institute, somehow, is burdened with an incompetent faculty member with tenure privileges, the appropriate alternatives for this type of situation may be to explore various alternatives by which this person could be improved. The concept of sunk costs, therefore, emphasizes ignoring past wrong investment decisions for future decision making. It should not, however, be implied that lessons from past mistakes should not be learned.

9. Private, Governmental and Societal Costs

Private, governmental and societal costs are referred to as costs to the students, government and society. While costing educational programs, it is very important to keep in mind from whose viewpoint the costs were being determined. Opportunity costs should also be included while calculating these type of costs. For example, the costs to students getting an education may include the loss in income due to their presence in education (opportunity costs) besides other costs like tuition, lodging, board and so on. Similarly, opportunity costs should be included in governmental and societal costs. The main difference between the governmental and societal costs is that, whereas the governmental costs include the financial burden borne by the government in financing education plus the loss in potential

taxes due to the students being in the educational sector rather than being employed in the economy, societal costs may include the financial burden borne by the society in sustaining the educational system plus the loss in the gross national product due to the students being in education rather than being a productive member of the society. A detailed identification of societal costs and how to measure these is discussed in subsequent sections.

10. Standard Costs

A standard cost has two components, a standard and cost. A standard is like a norm and whatever is considered normal can generally be accepted as standard. For example, if a score of 72 is the standard for a golf course, a golfer's score is judged on the basis of this standard. Standard costs are the predetermined costs of producing a single unit or a number of units in the immediate future. They are planned costs of a product under current and/or anticipated operating conditions.

In industry, the standard costs for making various products are set and are based on carefully determined quantitative and qualitive measurements and engineering methods. These standards are considered as norms in terms of specific items, such as pounds of materials, hours of direct and indirect labor required, hours of plant capacity used, and so on. In many firms a standard is operative for a long time. A change is needed when production methods or materials change. In education, the standard costs for producing graduates of various vocational programs have not been established either at the district or state levels. The implications of standard costs for various educational programs are that these would help in controlling costs, measuring costs and promote possible cost reduction.

Various cost concepts and terminology were introduced to facilitate the task of establishing societal costs of vocational programs. A discussion of such a procedure follows and should be primarily used for establishing unit cost studies or determining the average cost of producing a graduate of a program.

B. PROCEDURES FOR ESTABLISHING SOCIETAL COSTS OF VOCATIONAL PROGRAMS

Procedures for establishing societal costs of vocational programs involve the steps listed below:

A. Identification of societal costs.

B. Developing direct or proxy measures for the identified societal costs.

C. Measuring the societal costs.

D. Preparing and analyzing the results of the societal costs.

The above steps are discussed in detail below.

C. IDENTIFICATION OF SOCIETAL COSTS

The societal costs of vocational education programs may be looked upon as the opportunity cost of the resources (human and physical) released by society for conducting such programs. The opportunity cost of a resource to society was earlier defined as the next best use where such a resource could be deployed by the society. Economists consider all costs as opportunity costs. The rationale behind their thinking is that whenever a resource is employed for a certain use, it cannot be used for other purposes. Thus, there is a sacrifice involved in using a resource for a certain purpose, in so far as it excludes other opportunities that might have been chosen. The value of the best of these foregone opportunities is the true cost of the chosen alternative.

The societal costs of a vocational education program consist of two broad categories, namely, direct and indirect costs of the resources used in

instruction and the opportunity costs to society. The direct cost of instruction include the following elements.

1. Faculty costs
2. Facilities costs (buildings and equipment)
3. Supplies costs

The indirect costs of instruction include the costs of supportive services (salaries, facilities and supplies) and include the following elements:

1. Administrative services costs
2. Guidance and counseling services costs
3. Placement services costs
4. Student services costs (parking, housing, student activities - net expenditures)
5. Library services costs
6. Audio-visual services costs
7. Food services (net expenditure)
8. Financial aids to students
9. Other services costs

The opportunity costs to society of a vocational education program include the following elements.

1. Opportunity costs to society of the students enrolled in the educational program rather than being in the world of work and contributing towards the economic welfare of the society.
2. Opportunity costs to society due to the inherent nature of the educational system leading to a loss of such taxes as property tax, sales tax, etc.

D. MEASUREMENT OF SOCIETAL COSTS OF VOCATIONAL EDUCATION PROGRAMS

The measurement of societal costs of direct and indirect costs of instruction is rather a simple task, as all these costs could be measured directly in dollars. The detailed procedures for establishing societal direct and indirect costs of instruction of a vocational program are discussed in the following section of this chapter.

The opportunity costs to society due to the inherent nature of the educational system leading to a loss of such taxes as property tax, sales tax, etc. can also be measured directly in dollars. This can be done by including such taxes, assuming that the educational system was private sector and paying these taxes.

The opportunity cost to society of the students being in vocational programs rather than contributing towards the gross national product can be measured by proxy measure of income foregone by such students. However, this requires a consideration of the level of employment prevailing during the years of the training program. If the level of unemployment prevailing at a certain time is considerably more than the minimum acceptable level of unemployment;[1] it would be correct to consider the societal opportunity cost of the students as zero. It would be valid to assume that students would not be able to get jobs when the unemployment rate is high and thus be productive members of society even if they were not enrolled in the vocational programs.

E. PROCEDURES FOR ESTABLISHING SOCIETAL COSTS OF VOCATIONAL EDUCATION PROGRAMS

The direct cost of instruction of a vocational program could be established by aggregating the cost per student for various courses included in the

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[1]At present the minimum acceptable level of unemployment is considered as five percent. In other words, at this level of unemployment, the economy is considered to have full employment. The rationale for this is that there is bound to be some structural unemployment at all times due to the potential available workers being unable to find jobs which match with their skills or their inability to relocate.

program. Some of these courses may be required of such a program and the other courses may be elective. The courses included in a vocational program could also be used as required or elective courses by other vocational programs offered at the same institute. The first step in the costing of an instructional program is to develop a matrix called "Curriculum Matrix" which shows the relationships included in the vocational program and other vocational programs offered at the institute. The educational program is defined as a major area of instruction taken by students. For example, a student at entry or first semester level majoring in a two year machine shop program may be defined as belonging to program one and the same student at the second semester level may be defined as belonging to program two and so on.

The elements in the curriculum matrix may be filled in by putting one where a course was required of a student belonging to that program, zero where a course was irrelevant for that program, and a fraction between zero and one where the course was an elective for that program. The past data regarding the percentages of students enrolled from various programs in elective courses could be compiled, and such percentages be used for filling in the elements for the elective courses for various programs. For example, if there were 100 senior terminal semester students in a program and 10, 40, and 50 percent, respectively. How far should one go in collecting such data? It is felt that the data for the past two or three years should be enough for this purpose. An example of a curriculum matrix for a two-year machine shop program is shown in Table 2-1 which basically gives the course program relationship.[2]

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[2]Figure 2-1 was prepared by the author from the actual machine shop program offered at the Fox Valley Technical Institute, Appleton, Wisconsin in 1969-70.

Serial Number	Credit Hours	Contact Hours	Course Number	PROGRAM / COURSE TITLE	MACHINE SHOP				AUTO MECHANICS					AUTO BODY				PRINTING			
					First Semester	Second Semester	Third Semester	Fourth Semester		First Semester	Second Semester	Third Semester	Fourth Semester	First Semester	Second Semester	Third Semester	Fourth Semester	First Semester	Second Semester	Third Semester	Fourth Semester
1	7	15	420-324	MACHINE SHOP PRACTICE I	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2	4	4	420-336	MACHINE SHOP THEORY I	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
3	3	3	804-305	APPLIED MATHS I	1	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0
4	3	3	801-318	APPLIED COMMUNICATION I	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
5	2	3	421-306	BLUE PRINT READINGS	1	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
6	7	15	420-327	MACHINE SHOP PRACTICE II	0	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
7	4	4	420-339	MACHINE SHOP THEORY II	0	1	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
8	3	3	804-306	APPLIED MATHS II	0	1	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
9	3	4	806-306	APPLIED SCIENCE	0	1	0	0	9	0	0	0	1	0	0	0	0	0	1	0	0
10	2	3	421-309	BASIC MECHANICAL DRAFTING	0	1	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
11	7	15	420-330	MACHINE SHOP PRACTICE III	0	0	1	0	11	0	0	0	0	0	0	0	0	0	0	0	0
12	4	4	420-342	MACHINE SHOP THEORY III	0	0	1	0	12	0	0	0	0	0	0	0	0	0	0	0	0
13	3	3	809-303	HUMAN RELATIONS	0	0	1	0	13	0	0	0	0	0	0	0	0	0	0	0	1
14	3	4	422-303	BASIC METALLURGY	0	0	1	0	14	0	0	0	0	0	0	0	0	0	0	0	0
15	2	4	442-321	WELDING MACHINE TOOL	0	0	1	0	15	0	0	0	0	0	0	0	0	0	0	0	0
16	7	15	420-333	MACHINE SHOP PRACTICE IV	0	0	0	1	16	0	0	0	0	0	0	0	0	0	0	0	0
17	4	4	420-345	MACHINE SHOP THEORY IV	0	0	0	1	17	0	0	0	0	0	0	0	0	0	0	0	0
18	2	2	419-306	HYDRAULICS & PNEUMATICS	0	0	0	1	18	0	0	0	1	0	0	0	0	0	0	0	0
19	2	4	420-311	INDUSTRIAL PROCESSES	0	0	0	1	19	0	0	1	0	0	0	0	1	0	0	0	0
20	3	3	444-306	NUMERICAL CONTROL	0	0	0	1	20	0	0	0	0	0	0	0	0	0	0	0	0
21	3	4	420-357	TOOL, FIXTURE, AND INSPECTION	0	0	0	1	21	0	0	0	0	0	0	0	0	0	0	0	0

Figure 2-1

Curriculum Matrix Showing Relationships Between Machine Shop and Other Programs Offered At A Vocational Institute

The rows of Figure 2-1 indicate the courses included in the machine shop program and the columns denote the various programs at the institute that used these courses. The elements in this table are either one or zero; the element one implies that a course is required of a program indicated in the column, the element zero indicates that a course was neither required of a program, nor was it used as an elective. If a course was used as an elective by a program, a fraction between zero and one may be entered in the cell, the fraction representing the historical fraction data does not exist, this percentage may be based upon the opinion of the faculty or head of programs. The courses listed in Figure 2-1 were not used as elective courses by any program offered at the institute. It is pertinent to observe that most vocational programs are well laid out and allow very few elective courses in contrast to college or university level programs.

The curriculum matrix is very useful for establishing the direct instructional cost of a vocational program. This matrix serves primarily as a tool for projecting the demand for courses as a result of the students enrolled in various related programs. This is achieved by multiplying the curriculum matrix by the enrollment matrix to obtain the the projected number of students to be enrolled in these programs. The demand for various courses could be broken into a number of sections to be offered for various courses depending upon the class size policies for such courses. The inputs required in terms of faculty, space, equipment and supplies to meet the demand for various courses could be generated. Be cautioned, however, that any projection including course demand is subject to errors. Errors in course demand projection will be minimal in the following cases:

a. Rigidity of curricula structure within an educational institute: A rigid curriculum is defined as a curriculum, when the students

do not have the options to elect courses. A completely rigid curricula structure at an institute will be reflected by all elements in the curriculum matrix being one. The more rigid the curricula structure, the more reliable the projected demand for various courses will be.

b. Stability of curricula structure within an educational institute:
A stable curriculum is defined as one when the required and elective courses for various programs and the prerequisite courses for various required and elective courses do not undergo a change over a period of time. Another condition for the stability of the curricula structure is that the number of the courses offered do not change. The more stable the curricula structure at an institute, the more accurate the estimated demand for the courses included in the curriculum.

c. Stability of other factors affecting demand for various courses:
The other factors affecting course demand are listed below:

(i) Particular faculty member offering a course:
As stated earlier some of the faculty members may be more popular and may generate more demand for their courses especially in the case of elective courses.

(ii) Scheduling pattern of courses offered:
Some courses may be heavily demanded simply because they fit the scheduling pattern of the students for their programs.

(iii) System of electing courses:
Students left to themselves may elect courses randomly as compared to a system when these options are exercised with the advice of faculty members who have already prespecified the policies for this purpose through mutual consultation.

(iv) Time schedules for electing courses:

Some courses may be elected only when the students in various programs have attained certain prespecified academic standing and the others may be elected irrespective of the academic standing. The second case will introduce more errors in estimating demand for various courses than the first case.

(v) Prerequisite requirements for elective courses and the rigidity of its enforcement:

The greater the prerequisite requirements and the greater the rigidity with which this is enforced, the better the estimates which one can make for estimating the demand for various courses.

In spite of these errors that are inherent in the system, the curriculum matrix may provide a better estimate of the demand for various courses, which under the existing practices is mostly estimated either by a rule of thumb or arbitrarily.

The curriculum matrix should be kept updated by including new courses and programs and computing elements of the matrix which will reflect the latest trends in the enrollment pattern in elective courses.

The curriculum matrix, besides serving as a tool for projecting course demand and resource inputs required, may also serve as a basis for some of the policy decisions as to location of new programs and the expansion or contraction of exisitng programs. These policy decisions are discussed below:

1) Location of New Programs:

One criteria for deciding the location of a new program among several educational institutes could be the interrelationship among the proposed program and the existing programs at the various institutes. According to this criterion, the proposed program should be located

in an institute where it will promote the inter-relationship between the new and the existing programs. This may be obtained by taking the existing curriculum matrices of various institutes without the proposed program and finding a ratio between the sum of the numbers filled in the curriculum matrix. This ratio should again be computed for various institutes after the proposed program curriculum is incorporated. The difference between the second and the first ratios computed may serve as an index of the promotion of inter-relationships among various programs as a result of introducing the new program in various institutes. The maximal positive difference for an institute can serve as an indicator for locating the proposed program in that institute. The underlying rationale for using this criterion is that in inter-related programs, the costs of instruction may be low due to optimal or near optimal class size, and hence it may cost less.

The above indicator may be one among several other criteria such as location of students, availability of other appropriate non-instructional facilities, and so on.

2) Expansion or Contraction of Existing Programs:

The discussion regarding location of new programs can be extended to the policy decisions regarding expansion or contraction of the existing programs in various institutes. One of the criteria for deciding a particular institute may be to promote expansion due to its inter-relatedness with other programs and vice versa. Other criteria could be the quality of instruction, the incremental expenses or savings, intensity of demand on the part of local students, business, and industry and so on.

In summary, the curriculum matrix shows the relationship between various programs and courses, both on a required and elective basis, and can serve as a useful tool for estimating demand for various courses; determining resource inputs required as a result of demand for various courses, the effects of changes in an existing curriculum over the other existing curriculum; deciding about the location of a new program or the expansion or the contraction of the existing programs at an educational institute among several institutes. It is beyond the scope of this study to illustrate the application of the "Curriculum Matrix" for various purposes discussed above. Having established the Curriculum Matrix, the next step is to establish the inputs for teaching courses in a program. This is discussed below.

Step 2 - Establish Inputs For Teaching Courses

The inputs used directly for teaching courses in the Curriculum Matrix consist of the following:

A. Faculty

B. Space

C. Equipment

D. Supplies

Step 3 - Establish Cost For Inputs In Teaching Courses

The procedures for costing inputs used in teaching courses included in the curriculum matrix are discussed below. These procedures are directed towards establishing average societal cost per student rather than marginal or incremental costs.

Procedure For Costing Faculty Input

(i) Gross faculty salary, including fringe benefits, paid by society to the instructors for teaching a course in the curriculum should be identified. Let it be Z (dollars) per quarter or semester, as the case may be.

(ii) The percentage of instructional time allotted to teach the course as compared to the full teaching load should be determined. Let it be P (percent).

(iii) The instructor's cost for teaching the course should be arrived at by multiplying the gross faculty salary by the percentage of instructional time allotted for teaching the course. This is equal to $ZP.

(iv) The instructional cost of the course as determined by (iii) above should be divided by the actual enrollment in the course. Let the actual enrollment by N. The instructional cost per student for the course is equal it $ $\frac{ZP}{N}$.

Note. If a course has more than one section and is taught by different instructors, the instructional cost per student for each section as well as the average instructional cost per student for the course as a whole should be determined.

The above procedure for costing faculty input is illustrated with an example below.

Example Number 1, (Costing Faculty Input)

A course requiring three contact hours per week was taught over the last six semesters by instructors whose teaching loads in contact per week and gross salaries, fringe benefits, traveling, etc. is given in Table 2-1. The enrollment in the course is also given. Find the cost of faculty input per student for each semester and also the average cost for the last six semesters.

Table 2-1

Faculty Input Data For A Course

No.	Item	SEMESTER 1	2	3	4	5	6
1.	Instructor Code	01	01	02	03	02	02
2.	Instructor's Salary/ Semester (Gross)	$6000	$6500	$7000	$8000	$7300	$7800
3.	Fringe Benefits etc./ Semester	$ 300	$ 400	$ 450	$ 500	$ 550	$ 600
4.	Teaching Load in Contract Hours/Week	18	15	15	9	12	12
5.	Other Responsibilities Per Week	-	-	-	3	-	-
6.	Initial Enrollments	10	15	18	20	25	35
7.	Dropouts	-	2	1	3	2	3
8.	Failures	-	1	-	2	-	2

Solution To Example 1

The cost per student as far as faculty is concerned is illustrated for the data pretaining to the first semester.

Percentage of instructor's time spent on teaching course = $\frac{\text{contact hours of course/week}}{\text{full teaching load in contact hours/week}}$

$= \frac{3}{18} = .1667$

Faculty's gross salary + Fringe Benefits = $6000 + 300 = $6300 (for semester)

Faculty cost for teaching course = $6300 (1.667) = $1050.21

Faculty cost/student = $\frac{\$1050.21}{10} = \$105.02$

The faculty cost per student for teaching the course for semesters two to six could be found using the same procedure. The average cost per student for three years could be derived by dividing the sum of the average cost for the semesters by the number of semesters, six semesters in our example. This is shown below.

Average cost of faculty for three years (six semesters) =

$$= \frac{\$(105.02) + (92.00) + (82.78) + (106.25) + (78.50) + (60.00)}{6}$$

$$= \frac{\$524.55}{6} = \$87.42$$

Some explanations regarding faculty input data included in Table 2-1 may be given in order to make the costing procedure explicit. Line 2 of Table 2-1 indicates the gross salary of the instructor rather than take-home pay after taxes. The rationale for this is that society pays the instructor in terms of the gross pay rather than net pay. Line 3 includes such fringe benefits as social security, unemployment compensation, life insurance, traveling etc. Only that portion of the fringe benefits contributed by the state. If the faculty pays a portion of benefits such as social security, it should be excluded from the societal cost.

Line 4 shows teaching load in contact hours per week. The faculty teaching load in some institutes may be expressed in terms of credit hours per week. Contact hours per week are used rather than credit hours per week to express the teaching load, because faculty load expressed in credit hours per week creates confusion in cases where there are remedial courses taught without credits. Further, shop or laboratory courses generally have more contact hours per week as compared to the credits awarded for a course. It will be seen in subsequent sections that the costing of space and equipment inputs is easier when contact hours are used rather than credit hours.

Line 5 of Table 2-1 indicates "other responsibilities per week." This should be included only when release time is provided officially to perform such responsibilities. If no release time is provided for other responsibilities, it should not be included.

Lines 6, 7 and 8 indicate the initial enrollments, drop-outs, and failures in the course. For establishing average costs, only initial enrollments in the course should be used. The rationale for doing so is that generally the number of drop-outs and failures in vocational schools courses is not very large. Further, drop-outs could occur any time during the time that the course is offered. Moreover, the failures in the course do gain some knowledge, skills or change of attitudes in spite of the fact that they could not pass the course.

It will be noted in the above example, that in spite of the general increase in salary and decreased teaching loads, the average cost per student for the course decreased over time. This was due to continuously increasing enrollments in the course, as indicated in line 6 of Table 2-1. This illustrates the operation of the economies of scale in instruction. The inefficiencies in the instructional system due to low enrollment can be demonstrated by the following example.

Let us assume that the optimal enrollment for the course was 30 students. The average cost per student for the first semester based on this assumed enrollment is calculated and shown below.

Faculty cost for teaching course = $1,050.21 (calculated as before)

Average cost per student = $\frac{\$1,050.21}{30}$ = $35.01

The difference between actual average cost and assumed average cost based on optimal enrollment equals $(105.02) - (35.01) = $70.01

Thus, it would appear that the average cost of faculty for teaching the course was $70.01 more as compared to the average cost of faculty based on optimal enrollment. It may be of interest to note such inefficiencies inherent in the system due to low enrollments.

Procedures For Costing Space Input

(i) The initial capital outlay on land and buildings should be determined. Let it be $X for land acquisition cost and improvements made on it, and $Y for buildings.

(ii) The economic life of the buildings should be estimated. Let it be T years.

(iii) The building cost ($Y) should be prorated over the economic life of the building in order to find the annual costs. Thus the annual cost = $ $\frac{X}{Y}$

Alternative:

The annual building costs should preferably be calculated by the following formula to consider the time value of money to the society.[3]

Annual Costs of Building[4] = (Y) (Capital Recovery Factor at i interest rate for T years.)

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[3]The time value of money concept states that if society had money, it could be employed for various purposes such as highways, health-care programs, flood control projects, etc. These projects will give a return to the society on the dollars invested by it. The next best project alternative which was sacrificed due to investment in land and building in education and the return from such alternative project represents the societal time value of money. Since it is difficult to determine the societal preferences of alternative projects and rate of return on such projects, the interest rate used on school bonds in the year the building was constructed are used in the capital recovery factor which is discussed in detail later on.

[4]The numerical values of capital recovery factor used in calculating annual costs of building is given in Appendix A.

The interest rate i to be used in the formula will be the interest rate used on schools bonds in the year in which the building was constructed. The annual cost by this alternative method will be higher than calculated by the straight line method.

(iv) The annual cost of land should be calculated by using the following formula.

Annual Cost of Land = ($X) (Interest rate)

The interest rate to be used should be the same as used in the capital recovery factor employed in the calculations for annual cost of buildings.

If state land has been used for constructing a school building and no cash payments to private parties are involved, the market value of the land should be used. Similarly, if a building is donated by the public involving no cash payment on the part of the government, the market value of the building at the time of acquisition should be used.

(v) The maintenance costs incurred should be determined for buildings and grounds.

(vi) The annual custodial and janitorial services for the buildings and land should be determined from the past data.

(vii) The annual costs for utilities should be determined.

(viii) The annual costs calculated in (iii) to (vi) above should be added to get one annual figure for the costs of the buildings and land.

(ix) The space areas used for instruction, administration and auxiliary services should be determined and the costs prorated among these services on the basis of actual space utilization.

(x) The space area occupied by different instructional rooms and the hours each room is utilized should be determined by multiplying

the space area for each room by the hours it is utilized. Let S_1, S_2, and S_n be the space areas occupied by n rooms. Further, let t_1, t_2, ... t_n be the hours each space area is used. Total space utilization equals $S_1 \times t_1 + S_2 \times t_2 + \ldots + S_n \times t_n$ (square feet hours).

(xi) The course space cost should be calculated by finding a percentage of total square feet hours used by the course and multiplying it by the instructional space cost as calculated in (ix) above.

(xii) The space cost per student is the space cost for the course as calculated in (x) above divided by the actual enrollment.

The above procedure for costing space input for determining space cost per student for teaching a course is illustrated by an example.

Example 2 (Costing Buildings and Land Inputs)

A shop course having 15 contact hours per week and using 2200 square feet area was taught in one of the buildings built 30 years ago at a cost of $360,000 and financed through bonds issued at 5 percent. The total cost of land including improvements at that time was $30,000. The remaining life of the building is estimated as 20 years with a negligible salvage or resale value. The total area of the building is 24,000 square feet, out of which 12,750 square feet is occupied by classrooms and shops; 6,000 square feet by offices of instructors and such student services as guidance, selection, placement; and 5,250 square feet by aisles, and rest rooms. The details of the area used for instruction are as given in Table 2-2.

Table 2-2

Details Of Instructional Area

No.	Type of Rooms	No. of Rooms	Area Per Room (Square feet)	Total Area (Square feet)
1	Lecture courses (30 capacity)	15	250	3,750
2	Lecture courses (50 capacity)	4	600	2,400
3	Shop courses (30 capacity)	3	2,200	6,600
				12,750

The usage of the instructional space is shown below in Table 2-3.

Table 2-3

Details of Instructional Areas Utilization

TYPE OF ROOM	AVERAGE USAGE PER WEEK (HOURS) DURING SEMESTERS					
	1	2	3	4	5	6
Lecture (30 capacity)	18	21	24	24	24	30
Lecture (50 capacity)	15	20	21	24	24	24
Shops (30 capacity)	25	25	30	30	30	35

Other expenses related to repairs, maintenance, etc. for the building are given in Table 2-4.

Table 2-4

Expenses Related To Repairs And Maintenance

	EXPENSES PER SEMESTER ($) DURING SEMESTERS					
ITEM OF EXPENSE	1	2	3	4	5	6
Janitorial	$3,000	3,300	3,800	4,000	3,500	3,800
Utilities (heat, light, etc.)	$ 300	500	350	550	400	600
Snow removal	-	400	-	300	-	600
Repairs & maintenance	1,000	200	1,500	300	2,000	400
Total for Semester	$4,300	4,400	5,650	5,150	5,900	5,400

The information regarding enrollment in the shop course is given below in Table 2-5.

Table 2-5

Enrollment in Shop Course

ENROLLMENT	SEMESTER					
INFORMATION ITEM	1	2	3	4	5	6
Enrollment (initial)	8	12	15	25	28	35
Dropouts	-	-	1	2	2	3
Failures	-	-	1	1	2	2

Find the space cost per student for this shop course based on actual enrollment. Find the average cost per student for space input. If the optimal enrollment in this course is 30 students, find the hypothetical space cost per student based on optimal enrollments. Find the average of the hypothetical space cost per student.

SOLUTION: Example 2

The cost per student for land and building is shown for the first semester.

Building Cost for Course

The annual capital cost of building equals initial building cost times capital recovery factor at bond interest rate for the estimated life of building, or $360,000 (.05478) = $19,720.80.

The total square feet of buildings used for instruction and office space[5] is 12,750 + 6,000 = 18,750 square feet.

Percentage of area used for instruction = $\frac{12,750}{18,750}$ = .68 or 68 percent

Annual capital cost of building assignable to instruction = ($19,720.80) x (.68) = $13,410.14.

Semester capital cost of building assignable to instruction = $\frac{\$13410\text{-}14}{2}$ = $6705-07

Space Utilization Calculation During First Semester

Lecture type (30 capacity) = (Area in square feet) x (Average usage per week in hours) = (3750) x (18) = 67,500 square feet hours.

Lecture type (50 capacity) = (Area in square feet) x (Average usage per week in hours) = (2400) x (15) = 36,000 square feet hours.

Shops (30 capacity) = (Area in square feet) x (Average usage per week in hours) = (6600) x (25) = 165,000

Total space utilization during first semester = 67,500 + 36,000 + 165,000 = 268,500 square feet hours.

Space utilization for the course = (Area in square feet) x (Contact hours of course) = (2200) x (15) = 33,000 square feet hours.

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[5]The area devoted to aisles, restrooms should be ignored. In our example, it was 5,250 square feet.

Percentage of space utilization for the course =

$$\frac{\text{Space utilization for the course}}{\text{Total space utilization during first semester}} = \frac{33000}{268,500} = .1129 \text{ (12.29 percent)}$$

Space cost of building for the course during first semester = Semester capital cost of building assignable to instruction X Percentage of space utilized for the course

= ($6705.07) x (.1229) = $824.05

Land Cost For Course

Annual cost of land = (Initial cost of land and improvement) x (Interest rate of school bonds)

= $30,000 (.05) = $1,500

Semester cost of land = $\frac{\$1500}{2}$ = $750

Semester land cost assignable to instruction = (Semester cost of land) x (Percentage of building used for instruction)

= ($750) x (.68) = $510

Semester land cost assignable to course = (Semester land cost assignable to instruction) x (Percentage of space utilization for the course)

= $510 (.1229) = $62.68

Maintenance and Repair Costs for Course

First semester repair and maintenance costs

Janitorial	= $3,000
Utilities	= 300
Repairs	= 1,000
Total Maintenance costs	= $4,300

Semester maintenance costs assignable to instruction =

(Total semester maintenance cost) x (Percentage of building used for instruction)

= $4,300 (.68) = $2924.00

Semester maintenance costs assignable to course = (Semester maintenance cost assigned to instruction) x (Percentage of space utilized for the course)

= $2924 (.1229) = $359.36

Sum of Space Costs for Course

Building costs	= $824.05
Land costs	= 62.68
Maintenance costs	= 359.36
Total	=$1246.09

Space Cost Per Student = $\frac{\text{Total space cost for course}}{\text{Initial Enrollments in Course}}$

= $\frac{\$1246.09}{8}$ = $155.75

Calculation of space costs per students for semesters two to six may be done the same way. The results of these calculations are given below:

Semester	2	3	4	5	6
Building Costs	$785.34	653.74	640.33	640.33	551.82
Land Costs	57.68	49.73	48.71	48.71	41.97
Maintenance Costs	338.40	374.60	334.44	383.15	302.21
Total Semester Costs	1181.42	1078.07	1023.48	1072.19	896.00
Initial Enrollment	12	15	25	28	35
Cost Per Student	98.45	71.87	40.94	38.29	25.60

The average space input cost per student for three years or six semesters could be computed by taking the average of the averages computed for each of the six semesters. This is shown below:

Average space input cost for the six semesters =

$\$(155.75) = \frac{(98 . 45) + (71 . 87) + (40 . 94) + (38 . 29) + (25 . 60)}{6}$

= $\frac{\$430 . 90}{6}$ = $71 . 82

It will be noted once again that the average space cost decreased over time due to increased enrollments in the course.

The hypothetical average space input cost for each semester if the enrollment in the course had been optimal or thirty students can be calculated by dividing total space cost for each semester by optimal enrollment in the course. This is shown below:

Semester	1	2	3	4	5	6
Total Space Cost for Semester ($) =	1246.09	1181.42	1078.07	1023.48	1072.19	896.00
Optimal Enrollment	30	30	30	30	30	30
Average Hypothetical space - Cost per Student ($) =	41.54	39.38	35.94	34.12	35.74	29.87

Once again the hypothetical average space cost per student could be compared with the actual average space cost for the course. The differences would indicate the level of efficiency at which the system was operating due to the enrollment factor.

Comments on the Solution

It will be noted that the initial cost of the building, $360,000, was multiplied by the capital recovery factor at 5 percent and 50 years. What is the capital recovery factor? This is explained with reference to the above example. If the school system borrowed $360,000 at 5 percent interest (compounded yearly) and planned to repay this loan in equal year end installments for 50 years, what would be the yearly installment? The yearly installment over a period of 50 years is calculated by multiplying the initial principle of the loan ($360,000) by the capital recovery factor at the interest rate charged for the period over which the entire loan is intended to be repaid. In our case, the yearly installment was $19,720.80. In other words, if the school system was to pay $19,720.80 at the end of

each year from year one to year 50, the entire debt obligations would be met. It would, therefore, be appropriate to say that the annual cost of the building is $19,720.80.

How may one figure out the annual cost of the building, if these were financed through current revenue rather than through bonds? The cost of the capital assets (buildings and equipment) should always be multiplied by the capital recovery factor at prevailing bond interest rates over the life of such capital assets, even if no borrowing is involved. The rationale for this is that it takes care of the time value of money invested by society in capital assets. The concept of time value of money was explained earlier in Footnote 3 of this chapter.

It will be noted that in our example, the annual cost of land was calculated by multiplying the initial cost of land, including development cost, by the interest rate at which school bonds are issued, rather than the capital recovery factor. The reason for using this procedure in the case of land is that land has infinite life as compared to the definite life of a building. If the initial cost of land at $30,000 was borrowed at 5 percent (compounded yearly) for an infinite period of time, the interest at the end of each year will be $1,500 ($30,000 x .05). In other words, if interest of $1,500 was paid from year one to year infinity, we will not be required to pay $30,000 towards the amount initially borrowed. Therefore, the annual cost of the land to society is $1,500. Once again, even if no borrowing is involved in financing the cost of land, the described procedure for establishing the annual cost of land should be followed.

How is the annual cost of capital assets established, if these are donated by the public or government? In such cases the market value of such assets should be established and the procedure described in the example

for costing such inputs should be used. The rationale for including the cost of capital assets for which no payments have been made by the school system is that we are trying to establish societal costs and that society did release resources for the educational system, which otherwise would have been used elsewhere in meeting other societal needs. .

PROCEDURES FOR COSTING SHOP EQUIPMENT INPUT

An inventory of the shop equipment should be taken along with the following information.

(1) Date of acquisition of equipment.

(2) The remaining economic life of equipment from the instructional point of view.

(3) The total economic life of equipment should be determined by adding (1) and (2) above. Let it be T years.

(4) The initial cost of the equipment (let it be $P), will be prorated over the economic life of the equipment as determined in (3) above. Thus, the annual cost of the equipment in the shop is equal to $\$\frac{P}{T}$.

Alternative

The above procedure ignores the time value of the money spent on the equipment. The preferred procedure for establishing the annual cost should be to use the following formula:

$P multiplied by the capital recovery factor at the prevailing bond interest rate for instructional life of equipment.

The above formula assumes that the salvage or resale value of the equipment at the end of its instructional life is negligible. If the equipment has significant salvage value at the end of its instructional life (let it be $L), then the following formula will be used to establish the annual societal cost of equipment:

($P-L)x(Capital recovery factor at the prevailing bond interest rate over instructional life)+L(Prevailing bond interest rate).

The above formula assumes that the salvage or resale value of the equipment at the end of its instructional life is negligible. If the equipment has significant salvage value at the end of its instructional life (let it be $L), then the following formula will be used to establish the annual societal cost of equipment:

($P-L)x(Capital recovery factor at the prevailing bond interest rate over instructional life)+L (Prevailing bond interest rate).

(5) The semester capital cost of the equipment for all courses taught in that shop should be determined by dividing the annual cost of the equipment established in Step (4) above by 2.

(6) The maintenance cost of the equipment should be determined for each semester.

(7) The semester capital cost Step (5) and the maintenance cost Step (6) should be added to calculate the total semester cost for equipment in a shop for all courses taught in that shop.

(8) The contact hours of all the courses taught in the shop should be determined. Let it be H hours.

(9) If the contact hours of a shop course are h hours of total H hours, the percentage of equipment used in the shop for that course is $\frac{h}{H}$. The semester cost of the equipment for the course is calculated as shown below:

$(\frac{h}{H})$x(Semester cost of equipment for all courses as calculated in Step (7) above).

(10) The cost per graduate should be determined by dividing the costs as calculated in Step (9) above by the actual enrollment.

Note that the equipment cost has been based on time utilization rather than actual utilization of equipment. It is very probable that actual utilization in the advanced courses may be greater than in the introductory courses. In order to remedy this situation, weights can be assigned for the actual utilization and the costs prorated according to the weighted utilization in different course.

The above procedure for establishing societal cost of the shop equipment is illustrated by an example.

Example 3 (Costing Equipment Input)

An introductory shop course having 5 contact hours per week used shop equipment for which the following data were collected and are given in Table 2-6 below.

Table 2-6

Data Regarding Equipment Used In A Shop Course

Information Item	Machines		
	A	B	C
Years Used (years)	10	15	20
Remaining Instructional Life (years)	5	5	-
Initial Purchase Price	$20,000	$10,000	$30,000
Salvage Value at the End of Instructional Life	$ 1,000	$ 500	$ 2,000

The equipment listed above was also used by an advanced course having 15 contact hours per week. The introductory and the advanced course were offered in both the semesters over the last two years. The actual enrollments in the introductory and the advanced courses are given below in Table 2-7.

Table 2-7

Enrollment Data Ragarding Courses Using Shop Equipment

Semesters	1	2	3	4
Introductory Course	10	12	15	20
Advanced Course	8	9	11	13

The maintenance and repair cost for the last four semesters are given below in Table 2-8.

Table 2-8

Maintenance and Repair Costs of Equipment

Semester	1	2	3	4
Maintenance & Repairs Machine A	$100	125	140	150
Maintenance & Repairs Machine B	$150	175	160	180
Maintenance & Repairs Machine C	$200	250	350	350
Total Maintenance & Repairs For Semester	$450	550	650	680

The school bonds 10 years ago were issued at 5 percent and prior to this period were issued at 4 percent.

Find the cost per student for shop equipment input for each of the above four semesters. Find the average cost per student for two years. If the optimal enrollments in the introductory and advanced course were considered as 25 and 20 students, find the hypothetical cost per student for

equipment input for six years. Find the average hypothetical costs per student. Compare the actual costs per student with the hypothetical costs per student and interpret the results. Compute the ratios of the actual cost per student and hypothetical cost per student and interpret the results for each semester.

Solution to Example 3 (Costing Equipment Input)

The cost of shop equipment for the first two semesters is computed below:

Initial cost of machine ($P) = $20,000

Total instructional life of Machine A (T years) = 10 + 5 = 15 years

Salvage value ($L) = $1,000

Annual cost of Machine A = (P-L) x (Capital recovery factor at bond rate of 5 percent over instructional life of 15 years). + L (School bond rate)

= $(20,000 - 1,000) (.09634) + (1,000) x (.05)

= $(19,000) (.09634) + 1,000 (.05)

= $1,830 . 46 + 50.00 = $1,880 . 46

Similarly, calculations for Machine B and C with annual costs of Machines B and C at 4 percent bond rate, and considering 20 years life on each machine and a salvage value of $500 and $2,000 respectively, are shown below:

Annual cost of Machine B = $(10000 - 500) (.07358) + 500 (.04)

= $(699 . 01) + (20.00) = $719 - 01

Annual cost of Machine C = $(30000 - 2000) (.07358) + 2000 (.04)

= $(2060 . 24) + (80 . 00) = $2140 . 24

Total annual capital costs of Machines A + B + C

= $(1880 . 46) + (719 . 01) + (2140 . 24)

= $4,739 . 71

Total semester capital costs of Machines A + B + C

$$= \frac{\$4,739 \ . \ 71}{2} = \$2,369 \ . \ 86$$

It may be pointed out that the value of capital revovery factor at a few selected interest rates and different time periods is given in Appendix A of this report. The reason for using 4 percent interest rate in the case of Machines B and C was that it was assumed that the school bond interest rate prevailing at the time of buying these machines was 4 percent. The interest rate in the case of Machine A was 5 percent.

The costs of Machines A, B and C were calculated similarly for the second year or semesters three and four.

Maintenance and repair costs of machines may now be added to the total semester capital costs calculated earlier. This has been shown below.

Semester	1	2	3	4
Capital cost of equipment ($) =	2,369.86	2,369.86	2,369.86	2,369.86
Maintenance & repair cost ($) =	450.00	550.00	650.00	680.00
Total capital and Maintenance costs ($) =	2,819.86	2,919.96	3,019.86	3,049.86

The semester capital and maintenance cost for equipment may be allocated between introductory and advanced courses. Since the contract hours of the introductory course are five and the advanced course are 15, the total hours of utilization of shop equipment comes to 20 hours. The introductory course should be allocated $\frac{5}{20}$, or one fourth, of total semester capital and maintenance cost; and the advanced course should be assigned $\frac{15}{20}$, or three fourths, of such costs. This has been shown below.

Semester	1	2	3	4
Costs assigned to Introductory Course ($) =	704.96	729.96	754.96	762.46
Costs assigned to Advanced Course ($) =	2,114.90	2,189.90	2,264.90	2,287.40
Total capital and Maintenance costs ($) =	2,819.86	2,919.86	3,019.86	3,049.86

The cost of shop equipment per student for each course could now be computed by dividing the costs assigned to each course for various semesters by the actual initial enrollment in the course. This shown on the below.

Semester	1	2	3	4
Equipment cost assigned to Introductory Course ($) =	704.96	729.96	754.96	762.46
Enrollment in Introductory Course (Nos.)	10	12	15	20
Equipment cost per student ($) =	70.49	60.83	50.33	38.12

Similarly cost per student for equipment in the advanced course was computed and were found as $264.36; $243.32; $205.90; and $175.95 for semesters one, two, three and four, respectively. The average cost for the last two years or four semesters for equipment input could be found by calculating the sum of the average costs for the four semesters and dividing it by four. The average cost for the introductory course using this procedure was calculated as:

$$\$54.94 = \left[\frac{(70.49) + (60.83) + (50.33) + (38.12)}{4} \right];$$ and the advanced course was calculated as:

$$\$22.38 = \left[\frac{(264.36) + (243.32) + (205.90) + (175.95)}{4} \right].$$

The hypothetical average costs based on the optimal enrollment of 25 students is calculated below along with the ratios of the actual and hypothetical average costs.

Semester	1	2	3	4
Equipment cost assigned to Introductory Course ($) =	704.96	729.96	754.96	762.46
Hypothetical optimal enrollment (Nos.)	25	25	25	25
Average hypothetical equipment cost (per student) ($) =	28.20	29.20	30.20	30.50
Actual average equipment cost ($) =	70.49	60.83	50.33	38.12
Ratio of hypothetical to actual average equipment costs	.40	.48	.60	.80

The ratios computed in the last line indicate that as far as equipment inputs are concerned for this shop, the system was operating at 40,48, 60 and 80 percent of efficiency during semesters one, two, three and four, respectively.

Comments on Example 3

All comments on the example for space input apply to equipment input as well. Some additional comments are given on the formula used for establishing the annual cost of machines. It will be recalled that annual cost of the machines was calculated by using the following formula:

$$\text{Annual cost of Machine} = (P - L) \times (C.R.F.)_t^i + Li$$

Where: P = First cost of the machine in dollars

L = Salvage value of the machine

$(C.R.F.)_t^i$ = Capital recovery factor at bond interest rate of i percent over the instructional life of the machine is estimated at t years.

i = School bond interest rate.

t = Instructional life of the equipment.

Using the above formula, the annual cost of Machine A was found as shown below:

$$\text{Annual cost of Machine A} = (20{,}000 - 1{,}000)\,(\text{C.R.F.})_{15}^{5\ \text{percent}} + 1{,}000\,(.05)$$

$$= 1{,}900\,(.09634) + 1{,}000\,(.05)$$

$$= 1{,}830.46 + 50.00$$

$$= \$1{,}880.46.$$

The logic underlying this formula could be explained as follows: If one was to borrow $19,000 at 5 percent interest rate and agrees to repay it in 15 equal year end payments (from year one to year five), the yearly repayment schedule would be $1,830.46. Furthermore, if a sum of $1,000 was borrowed at 5 percent interest rate and it was arranged to pay only the interest at the end of each of following years and to pay the entire principle of $1,000 at the end of the 15 years, the year end interest payment would come to $50.00 ($1,000 x .05). There would still be an obligation to pay $1,000 at the end of year 15; this amount could be repaid from the revenue realized from the sale of the old machine at the end of year 15. Thus, the annual societal cost of the machine comes out as ($1,830.46) + ($50.00) or $1,880.46.

Example 3 mentions the estimation of the total instructional life of the equipment. The difficult part in estimating the total instructional life of the equipment rests with the estimation of future life rather than past life. If there is a great deal of uncertainty about the projected future life of a capital asset, three types of estimates, namely pessimistic, most likely and optimistic could be prepared. The pessimistic estimate refers to the estimated future life if everything goes wrong mechanically with the machine or it becomes obsolete due to changing technology. Most likely estimates refer to the average expected future life based on historical data or experience of other similar machines. The optimistic estimate refers to the estimated future life if everything goes well mechanically with the machine and if the equipment does

not become obsolete due to changing technology. The above-mentioned three estimates could be changed into one estimate by using the following formula:

$$\text{Estimated future life of equipment} = \frac{\text{Pessimistic estimate} + 4\ \text{Most likely estimate} + \text{Optimistic estimate}}{6}$$

As an example, if in the above example, the pessimistic, most likely, and optimistic estimates for remaining life of Machine A were four, five and six years respectively, the estimated future life would be shown below:

$$\text{Estimated future life for Machine A} = \frac{4 + 4\ (5) + 6}{6} = \frac{4 + 20 + 6}{6} = \frac{30}{6} = 5 \text{ years}$$

COSTING PROCEDURE FOR SHOP SUPPLIES INPUTS

(1) Ideally, shop supplies costs for each course should be determined by charging the material costs to each individual course and the cost per graduate calculated by dividing this cost by the actual enrollment.

(2) If there is an overhead associated with supplies like purchasing, storing and issuing costs, it should be prorated on some rational basis such as the dollar value of the material used for different courses.

Example 4: (Costing Shop Supplies Inputs)

The information regarding a shop course and supplies inputs used over the last six semesters is given in Table 2-9.

Table 2-9
DATA REGARDING SUPPLIES USED IN A SHOP COURSE

Semester	1	2	3	4	5	6
Supplies Used ($) =	80	120	180	280	375	450
Initial enrollments (Nos)	8	10	15	20	25	30
Dropouts (Nos)	---	1	---	2	1	2
Failures (Nos)	---	1	1	2	2	3
Optimal enrollments (Nos)	25	25	25	25	25	25

Find the cost per student for supplies input based on actual and hypothetical enrollments. Find the average costs:

Solution: Example 4:

The cost per student for supplies input is shown below:

Semester	1	2	3	4	5	6
Supplies costs ($) =	80	120	180	280	375	450
Initial enrollments (Nos)	8	10	15	20	25	30
Supplies costs per student ($) =	10	12	12	14	15	15

The hypothetical supplies costs per student based on the optimal enrollment of 25 students would be the same as based on the actual enrollment. The reason for this is that the supplies cost is a variable cost or depends directly on the number of the students enrolled in the course. If the enrollment in the course increases or decreases, the supplies costs increase or decrease proportionately.

The procedures for costing inputs of instruction, namely faculty, space, equipment, and supplies were applied by the investigator to the machine shop program offered at Fox Valley Technical Institute, Appleton, Wisconsin during 1965-70. The results of the direct cost of instruction per student based on actual enrollment may be seen in Table 2.10. A breakdown of the direct costs of instruction per student based on actual enrollments may be seen in Table 2-11. The breakdown gives the costs for faculty, space, equipment and supplies inputs in instruction.[5]

AUXILIARY AND SUPPORTIVE SERVICES INPUT

(1) The salaries, fringe benefits, etc., of staff associated with an auxiliary service should be determined.

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5. For more details see Mehar C. Arora, "Methodology for Establishing Production and Cost Functions of Vocational Education Programs." Unpublished doctoral dissertation, University of Minnesota, Minneapolis, Minnesota, June, 1975.

Table 2-10

DIRECT COSTS OF INSTRUCTION PER STUDENT BASED ON ACTUAL ENROLLMENTS ($)

NO.	COURSE	COURSE NO.	1965	1966	1967	1968	1969	1970
1	MACHINE SHOP THEORY I	420-336	53.99	52.57	41.81	49.16	36.09	32.95
2	MACHINE SHOP PRACTICE I	420-324	274.55	259.51	207.33	235.62	213.02	183.72
3	BASIC MATHEMATICS	804-305	20.80	21.21	26.02	34.37	34.55	19.80
4	APPLIED COMMUNICATION I	801-318	20.57	21.85	19.31	26.26	28.58	23.85
5	SKETCHING AND PROJECTION	421-306	55.20	51.28	39.71	43.08	53.37	33.85
6	ORIENTATION I		5.00	5.74	4.87	5.57	-	-
7	TOTAL MACHINE SHOP 1ST SEM.		430.11	412.16	339.13	394.06	365.61	294.17
8	MACHINE SHOP THEORY II	420-339	80.98	86.19	43.49	58.09	54.12	38.77
9	MACHINE SHOP PRACTICE II	420-327	411.33	306.43	216.91	278.88	317.77	216.21
10	BASIC DRWG. & BLUEPRINT RDG.	421-309	126.05	95.05	69.82	49.35	43.50	38.87
11	APPLIED MATHEMATICS	804-326	27.45	22.84	27.27	30.07	41.44	21.28
12	APPLIED SCIENCE I	806-306	24.40	26.28	30.31	40.08	38.78	37.03
13	ORIENTATION II		4.86	5.58	4.73	5.42	-	-
14	TOTAL MACHINE SHOP 2ND SEM.		675.07	542.37	392.53	461.89	495.61	352.16
15	MACHINE SHOP THEORY III	420-342	121.49	95.59	72.49	40.30	42.60	46.16
16	MACHINE SHOP PRACTICE III	420-330	613.49	469.76	356.50	221.28	264.91	278.77
17	HUMAN RELATIONS	809-303	7.81	10.35	12.28	12.89	24.19	25.46
18	BASIC METALLURGY	422-303	132.52	105.30	82.07	47.56	51.29	62.38

Table 2-10 Continued

NO.	COURSE	COURSE NO.	1965	1966	1967	1968	1969	1970
19	APPLIED SCIENCE II	806-306	91.52	72.15	40.82	48.28	-	-
20	NUMERICAL CONTROL	404-306	82.61	64.80	49.18	25.31	-	-
21	WELDING	442-321	-	-	-	-	52.47	53.62
22	TOTAL MACHINE SHOP 3RD SEM.		1049.44	817.95	613.34	395.62	435.46	466.39
23	NUMERICAL CONTROL	404-306	-	-	-	-	34.13	41.69
24	WELDING	442-321	72.69	68.20	71.91	58.89	-	-
25	MACHINE SHOP THEORY IV	420-345	138.84	114.64	118.70	48.76	52.09	63.49
26	MACHINE SHOP PRACTICE IV	420-333	701.13	573.61	590.17	267.28	322.99	381.33
27	HYDRAULICS AND PNEUMATICS	419-306	43.96	38.64	40.66	45.49	38.55	39.89
28	INDUSTRIAL PROCESSES	402-311	22.17	18.73	18.37	19.27	29.58	29.05
29	TOOLING AND FIXTURE DESIGN	420-357	129.81	108.04	111.21	42.38	55.35	64.93
30	TOTAL MACHINE SHOP 4TH SEM.		1108.60	921.86	951.02	482.07	532.69	620.38
31	MACHINE SHOP FIRST SEM.		430.11	412.16	339.13	394.06	365.61	294.17
32	MACHINE SHOP SECOND SEM.		675.07	542.37	392.53	461.89	495.61	352.16
33	MACHINE SHOP THIRD SEM.		1049.44	817.95	613.34	395.62	435.46	466.39
34	MACHINE SHOP FOURTH SEM.		1108.60	921.86	951.02	482.07	532.69	620.38
35	TOTAL MACHINE SHOP MAJOR PROGRAM		3263.22	2694.34	2296.02	1733.64	1829.37	1733.10

Table 2-11

BREAKDOWN OF DIRECT COSTS OF INSTRUCTION
PER STUDENT FOR MACHINE SHOP PROGRAMS
BASED ON ACTUAL ENROLLMENTS

NO.	COST ITEM	1965	1966	1967	1968	1969	1970
	MACHINE SHOP FIRST SEMESTER						
1	FACULTY	281.94	278.18	231.60	280.37	263.08	216.92
2	SPACE	55.23	50.09	34.21	39.11	34.59	25.33
3	EQUIPMENT	87.94	78.79	62.32	68.58	61.44	45.11
4	SUPPLIES	5.00	5.00	6.00	6.00	6.50	6.75
	TOTAL FIRST SEMESTER	430.11	412.06	339.13	394.06	365.61	294.11
	MACHINE SHOP SECOND SEMESTER						
5	FACULTY	443.26	375.27	272.25	326.89	350.61	260.55
6	SPACE	85.40	61.29	43.36	46.07	48.59	30.14
7	EQUIPMENT	139.41	98.81	69.42	81.43	88.41	53.47
8	SUPPLIES	7.00	7.00	7.50	7.50	8.00	8.00
	TOTAL SECOND SEMESTER	675.07	542.37	392.53	461.89	495.61	352.16

Table 2-11 Continued

NO.	COST ITEM	1965	1966	1967	1968	1969	1970
	MACHINE SHOP THIRD SEMESTER						
9	FACULTY	710.97	567.46	421.96	257.88	256.68	286.75
10	SPACE	127.49	92.95	68.35	44.86	44.06	43.92
11	EQUIPMENT	195.98	142.54	107.03	76.88	109.22	109.22
12	SUPPLIES	15.00	15.00	16.00	16.00	25.50	26.50
	TOTAL THIRD SEMESTER	1,049.44	817.95	613.34	395.62	435.46	466.39
	MACHINE SHOP FOURTH SEMESTER						
13	FACULTY	670.91	572.63	597.40	273.47	361.22	429.62
14	SPACE	135.97	104.49	104.25	52.72	54.00	60.20
15	EQUIPMENT	285.72	228.74	232.37	138.88	108.47	121.06
16	SUPPLIES	16.00	16.00	17.00	17.00	9.00	9.50
	TOTAL FOURTH SEMESTER	1,108.60	921.86	951.02	482.07	532.69	620.38
	MACHINE SHOP MAJOR PROGRAM						
17	FACULTY	2,107.08	1,793.54	1,523.21	1,138.61	1,231.59	1,193.84
18	SPACE	404.09	308.82	255.17	182.76	181.24	159.59
19	EQUIPMENT	709.05	548.98	471.14	365.77	367.54	328.92
20	SUPPLIES	43.00	43.00	46.50	46.50	49.00	50.75
	GRAND TOTAL MAJOR PROGRAM	3,263.22	2,694.34	2,296.02	1,733.64	1,829.37	1,733.10

(2) The expense due to supplies associated with an auxiliary service should be determined.

(3) The buildings costs associated with an auxiliary service should be determined as discussed earlier.

(4) The equipment costs associated with an auxiliary service should be determined and prorated among the economic life of the equipment.

(5) Items 1 to 4 should be added to get one figure for annual expenses connected with an auxiliary service.

(6) Any revenue. e.g., sales of food, etc., should be deducted from the total annual expenses as determined in Item 4 above and the net annual expenses calculated for the auxiliary service.

(7) The net annual expenses as determined in Item 6 above should be divided by two to arrive at the semester cost of an auxiliary service, which should be allocated to various vocational programs on some appropriate basis. Some of the feasible basis for allocating such costs of auxiliary services are shown below:

a. Actual time spent for various instructional and noninstructional programs.

b. Staff hired by different departments.

c. Number of students in various programs.

d. Number of credit hours generated by different departments.

e. Number of contact hours generated by different departments.

The above procedures are illustrated by an example.

Example 5: (Costing Guidance & Counseling Service)

Information regarding guidance and counseling service provided at a school is given for the four semesters in Table 2-12.

TABLE 2-12
DATA REGARDING GUIDANCE AND COUNSELING SERVICES

No.	Information Item	Semesters 1	2	3	4
1.	Number of Counselors	1	1	1	2
2.	Total Salaries, etc., per semester including fringe benefits ($)	5,000	5,500	6,000	12,000
3.	Office Space (Square feet) (For other information regarding buildings see example for space input discussed earlier.)	150	150	150	300
4.	Supplies Used ($)	1,000	1,600	2,000	2,500
5.	Office Equipment at Purchase Price ($)	600	650	650	1,400
6.	Total Life of Equipment (Years)	15	15	15	15
7.	Total School Enrollment	2,000	2,500	3,000	4,000
8.	Enrollment by Major Programs				
	Program A	500	400	400	300
	Program B	600	800	1,000	1,500
	Program C	700	800	1,000	1,500
	Program D	200	500	600	700
9.	Contact Hours Generated by Departments				
	Department J	6,000	7,000	8,000	10,000
	Department K	8,000	10,000	12,000	14,000
	Department L	8,000	12,000	13,000	20,000
	Department M	6,000	7,000	7,000	10,000
	Department N	2,000	4,000	5,000	6,000
	Total Contact Hours Generated:	30,000	40,000	45,000	60,000

Find the cost per student for guidance services using as a basis the information which has been provided above.

Solution to Example 5:

The cost per student for guidance and counseling services for various programs has been calculated as shown below:

Semester		1	2	3	4
Staff cost	$	5,000	5,500	6,000	12,000
Space cost	$	119	120	130	253
Equipment cost	$	58	63	63	135
Supplies cost	$	1,000	1,600	2,000	2,500
Total Semester Costs:	$	6,177	7,333	8,193	14,888

The calculation of space and equipment cost for the semester are given below. The space cost was based on the data of Example 2 dicussed earlier in connection with space input. It will be recalled that the annual building cost was $19,720.80 with a usable space of 18,750 square feet. Since the guidance and counseling services use 150 square feet during the first three semesters, the annual cost of space cost is equal to:

($19,720.80) x $\frac{(150)}{(18,750)}$ or $157.77.

During the fourth semester, guidance and counseling services used 300 square feet. The building cost for the fourth semester is equal to:

($19,720.80) x $\frac{(300)}{(18,720)}$ or $315.54.

Similarly, the annual cost of land associated with guidance & counseling services for the first three semesters is equal to ($750) x $\frac{(150)}{(18,750)}$ or $12.00 and for the fourth semester it is equal to $24.00. Other expenses for repairs and maintenance for the first three semesters amounted to $4300, $4400, and $5650 and could be allocated by multiplying these figures by $\frac{150}{18,750}$ or .008. For the fourth semester, other expenses for repairs and

maintenance of $5,150 could be allocated by multiplying by $\frac{300}{18,750}$ or by .016. This resulted in the repairs and maintenance cost of $34.40, $35.20, $45.20 and $82.40 for semseters one, two, three and four, respectively. The annual costs of buildings, land, and other expenses were added and then divided by two to get the space cost for the semester. It may be pointed out that the results shown in the solution are rounded to the nearest dollar.

The equipment costs were calculated by multiplying the costs with capital recovery factor at 5 percent for 15 years and rounded to the nearest dollar.

The cost per student for guidance and counseling services could now be computed for various semesters by using student enrollment as the basis. This is shown below:

Semester		1	2	3	4
Guidance and Counseling Costs	($)	6,262	7,368	8,278	15,057
Enrollment	(Nos.)	2,000	2,500	3,000	4,000
Cost per Student	($)	3.13	2.95	2.76	3.76

The guidnace and counseling cost per student could also be found by prorating such costs on the basis of contact hours generated. This is shown below:

Semester		1	2	3	4
Guidance and Counseling Costs	($)	6,262	7,368	8,278	15,057
Enrollment	(Nos.)	30,000	40,000	45,000	60,000
Cost per Contact Hour	($)	.2087	.1842	.1839	.2509

The cost per student by program could be found by multiplying the cost per contact hour by the average number of contact hours generated per student in that program. For example, if Machine Shop Semester 1 program on an average generates 30 contact hours, the cost of guidance and counseling services for that program during the first semester would be $30 x .2087 or $6.26.

Comments on Example:

The two methods of allocating guidance and counseling costs to various vocational programs would give different results. Which of the two alternative methods are better? The author of this report can not specify the best basis for allocating joint costs like that of guidance and counseling service amoung various vocational programs. One of the purposes of this manual was to standardize costing procedure of vocational programs in all the vocational institutes in Wisconsin. The investigator recommends that the basis for allocating joint costs be decided jointly by all the vocational institutes. However, it is recommended strongly that the basis for allocation of joint costs be such that reliable information for these be available and the cost of collecting such information be minimal.

PROCEDURES FOR COSTING ADMINISTRATION INPUT AT DEPARTMENTAL LEVEL

(1) The salaries and fringe benefits of administrators and office employees should be determined on semester basis along with other associated expenses connected with administration.

(2) The cost of office equipment for a semester should be determined in the same way as shop equipment used for instruction.

(3) The space costs for administration for a semester should be determined in the same way as the space cost for instructional services.

(4) Items 1 and 3 should be added to get one figure for administrative expenses at the departmental level, and this amount should be prorated on some appropriate basis to determine the cost per student for administrative input at departmental level.

Some of the feasible bases for prorating administrative input costs could be the following:

(a) Number of faculty members in the department.

(b) Number of courses offered by a department duly weighted by credit or contact hours of each course.

(c) Number of credit hours generated by a department.

(d) Number of contact hours generated by a department.

No example for administrative input at the departmental level is given. The example given in connection with guidance and counseling services could apply to the administration cost at the departmental level.

PROCEDURES FOR COSTING ADMINISTRATION INPUT AT INSTITUTIONAL, DISTRICT, STATE, AND FEDERAL LEVELS

All expenses incurred on salaries, buildings, equipment and supplies at a particular higher level should be prorated among different sublevels until it filters down to the desired level of vocational programs. The procedure for allocating joint costs form a higher level to successive lower levels is called a stepdown procedure of allocating joint costs and may involve different bases for allocating such costs. The selection of a particular basis depends upon the particular objective for which costs are being established, the availability of data, cost of collecting information, and the degree of accuracy desired. These bases should be mutually agreed upon to standardize the costing procedures.

The direct and indirect costs of vocational programs can now be calculated. The cost per graduate of a vocational program should have the following breakdown:

Direct Costs of Instruction

Faculty cost per student for courses included in the vocational programs = $____

Space cost per student for courses included in the vocational program = $____

Equipment cost per student for courses included in the vocational program= $____

Supplies cost per student for courses included in the vocational program = $____

Total direct cost of instruction per student for vocational program = $____

Indirect costs

Auxiliary & Support Services Costs

Staff cost per student for an auxiliary service provided to the program = $____

Space cost per student for an auxiliary service provided to the program = $____

Equipment cost per student for an auxiliary service provided to the program= $____

Supplies cost per student for an auxiliary service provided to the program = $____

Total indirect costs per student for auxiliary service provided to program = $____

Administrative Costs At Departmental, District, State, & Federal Levels

Cost per student for federal level administrative services = $____

Cost per student for state level administrative services = $____

Cost per student for district level administrative services = $____

Cost per student for departmental level administrative services = $____

Total administrative costs per student = $____

The total of all direct and indirect societal costs may now be shown below:

Total direct cost of instruction per student for a vocational program = $____

Total auxiliary services costs per student for a vocational program = $____

Total administrative costs per student for a vocational program = $____

Grand Total = $____

The grand total on the preceding pa e for the cost per student does not include societal opportunity costs. Two types of societal opportunity costs were identified earlier and are listed below:

1. Opportunity costs to society for the students enrolled in the educational program rather than being in the world of work and contributing to the economic welfare of the society.
2. Opportunity costs to society due to the inherent nature of the educational system leading to a loss of such taxes as property tax, sales tas, etc.

The measurement of the above mentioned societal opportunity costs may be accomplished as discussed below.

PROCEDURES FOR ESTABLISHING OPPORTUNITY COSTS OF STUDENTS TO SOCIETY

The rationale for including opportunity costs of the students enrolled in vocational programs is that society suffers an economic loss when students are in the educational system rather than the world of work. This, however, assumes that the students would be able to get jobs if they were not enrolled. This assumption may be true under a state of full employment economy. The economists consider a full employment economy at a 5 percent level of unemployment. The rationale behind their thinking was discussed earlier.

In order to measure the opportunity costs of students to the society, the formation of a cohort group of high school graduates who did not go for advanced education is suggested. Such a cohort group should have the same characteristics (as much as possible) as the students who enrolled in the vocational programs. Some of the suggested characteristics to be matched for these two groups include: high school curriculum, performance during high school (including I.Q.), socio-economic backgrounds of the two groups,

and the location of the graduates (urban, rural, metropolitan area).[6] The gross income earned (before taxes) including fringe benefits paid by the society to the cohort group should serve as a proxy measure of the opportunity cost of students to the society. This is illustrated by an example.

Example 6: (Opportunity Cost of Students to Society)

Five students are enrolled in a two-year machine shop program offered at a post-secondary vocational technical school. It is planned to establish the societal opportunity cost of students enrolled in the post-secondary vocational technical school. Therefore, a cohort group of 5 students was carefully selected matching the socio-economic and educational characteristics of the students on a one to one basis. The gross income earned by the cohort group for each individual student was observed for the period of time for the vocational program and is given below:

Student No.	Monthly Gross Wages Earned Including Fringe Benefits
1	$500 for the first 3 months; $550 for the next 6 months; $650 for the next 12 months.
2	Unemployed for the first 3 months; $550 for the next 6 months; $550 for the next 12 months.
3	Unemployed for the first 4 months; $550 for the next 12 months; $600 for the next 5 months.
4	$525 for the first 6 months; $600 for the next 12 months; unemployed for the next 3 months.
5	$475 for the first 6 months; unemployed for the next 3 months; $550 for the next 12 months.

The machine shop program students' history of wages earned during the summer vacations of three months is given on the next page:

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6. The details of the characteristics for the experimental and control groups may be seen in Section I of Chapter V which deals with an information system for the analysis of benefits and costs of vocational programs.

Student No.	Monthly Gross Wages Earned Including Fringe Benefits During Summer
1	$650 for 3 months.
2	$550 for 3 months.
3	$700 for 3 months.
4	$675 for 3 months.
5	Unemployed during the 3 summer months.

Find the societal opportunity costs of the students enrolled in vocational programs rather than being in the world of work.

Solution: Example 6:

The total gross wages earned by cohoert or experimental groups of five students over a period of 21 months come to $47,900; and the total gross wages earned by the students enrolled in the machine shop program or the control group amounted to $7,025. The societal opportunity cost of the student is equal to ($47,900 - 7,025) or $40,875. The societal opportunity cost per student is equal to ($40,875 ÷ 5) or $8,175 for the entire period of vocational program.

Comments on Example

It is very important that the cohort or experimental group be selected at the time the machine shop program starts. It will not be possible to match completely the characteristics of the two groups on a one-to-one basis. Therefore, matching characteristics should be done as much as is practical.

It may be mentioned that in our example, employment and wage data of the cohort group for 21 months only was collected because actual teaching took place in 18 months of the two years, and there was a summer vacation of three months in the middle of the two-year program. Since four out of

five students enrolled in the machine shop program worked during the summer break, the gross wages earned by them during the summer were adjusted by subtracting $7,025 from $47,900 to arrive at the societal opportunity cost.

The above method of computing societal opportunity costs of students automatically takes care of the variables due to the state of unemployment in the economy.

PROCEDURES FOR ESTABLISHING SOCIETAL OPPORTUNITY COST DUE TO THE INHERENT NATURE OF THE EDUCATIONAL SYSTEM

The educational systems are exempt from such taxes as property tax, sales tax, etc. Such exemptions do represent societal opportunity costs. Economists have different viewpoints on including such societal opportunity costs. One group of economists favors including such costs to arrive at true social costs. The other group favors excluding such costs because they serve no useful purpose. The author believes in including such costs, if average societal costs are being established, and excluding these, if marginal and incremental societal costs are being established. The rationale for including these costs for the purpose of establishing average societal cost is that their inclusion, as said earlier, would represent true average societal costs. The rational for excluding such opportunity societal costs in establishing marginal or incremental societal costs is that these are not affected by the foregone property or sales tax losses. Since this manual is primarily directed towards procedures for establishing average societal costs and benefits of vocational programs, the procedure for measuring societal opportunity costs due to the inherent nature of the educational system is discussed below.

The measurement of societal opportunity cost due to the inherent nature of the educational system is a simple task. All one has to do is to include the property tax on the buildings, equipment, and inventory as if it was

being assessed at the current rate. Similarly, the societal opportunity cost due to sales tax could be established as if sales tax was being paid on the purchases made. The cost per graduate of the societal opportunity cost could be established by allocating such opportunity costs using an appropriate basis mutually agreed upon by different parties in the education system.

Comments on Societal Opportunity Costs

It is important that the grand total societal cost per student should show the detailed breakdown of all the costs. Such a breakdown of costs will give the user of cost information what is included in the societal costs.

A NOTE: ON-THE-JOB TRAINING PROGRAMS

Vocational programs often involve some kind of on-the-job training. The degree of such on-the-job experience varies from program to program. As an example, nursing programs require some course work offered in the vocational institutes which is followed by on-the-job experience. Some apprenticeship programs require a lot of on-the-job experience along with some coursework at the vocational institutes. How does one establish societal costs of such programs? This is discussed briefly in this section.

The procedures for costing direct and indirect cost of instruction and the societal opportunity costs could be applied to the coursework taken at the vocational institute. The societal cost of the on-the-job experience could be established by calculating direct and indirect costs of on-the-job experience. The direct cost of on-the-job experience would include the cost of the training staff, space, equipment

and supplies used in such training. The indirect cost of the on-the-job would include the cost of supportive and administrative services used for on-the-job training. Thus, the costing procedures of direct and indirect on-the-job training would be the same as discussed earlier. If the students are paid some stipend or remuneration for getting on-the-job training, it should be regarded as societal cost.

It should be noted that even if the vocational school system does not pay for on-the-job training, yet it should be included in the societal cost of a vocational program. The rationale for including such costs in the cosietal costs is that society provides resources for programs involving on-the-job experiences. Therefore, the cost of such resources used should be included in the societal costs. The breakdown of societal costs of a vocational program should show the societal system which incurred the costs.

PROBLEMS AND ISSUES IN ESTABLISHING EDUCATIONAL COSTS

The procedures for establishing societal costs of a vocational program per student were discussed in detail in the earlier sections. Readers should be aware of some of the problems and issues in establishing educational costs, which is more of an art rather than a science. Some of the problems and issues are discussed below:

1. Lack of Proper Cost Information

The existing cost data in most of the vocational institutes is based on "Handbook II - Financial Accounting for Local and State School Systems," issued by the United States Office of Education. The current available data on costs of vocational programs is not only inadequate, but also kept

in such a way that they do not lend themselves to coherent analytical studies. There is no standard system of cost accounting among various districts and costs are scattered around different types of administrative forms. Some of the costs may be ignored as there is no administrative requirement to record these. Cost data collected is more often not associated with primary occupational categories or by specific courses. Fortunately, one of the basic largest item of expense, namely, instructional services, is readily available to determine the costs by courses and occupational programs. There is a need for a reasonable method of computing other indirect costs of education by courses and programs, so that expenses could be identified with the end purposes.

2. Establishing Unit for Education Costs

It was suggested to use contact hours as the basic unit for costing vocational programs. However, there could be other basic units like cost per credit hour, the cost per daily attendance, the cost per full time equivalent student and so on. The dimension of these basic units could be added by associating these units with the level of education such as first year student, second year student; or first semester student, second semester student, and so on.

What is the best basic unit for the purpose of costing educational programs? There is no best answer to this question. However, it is felt that the basic unit should be such that it could be used to make inter-school comparison of similar programs and service rendered by different school systems. Further the cost of collecting information regarding basic unit cost information should be amendable to analysis as to whether it was too much or too little.

Allocation of Overhead and Joint Costs

One of the biggest problems in determining education costs involves the allocation of overhead and joint costs. The problem of joint costs occurs when a facility or service is used for two or more distinct outputs.

The allocation of overhead and joint costs involves the selection of proper bases for allocating. Some of the bases which could be used in allocating such costs are listed below:

(a) Dollar volume of expenditure

(b) Full time equivalent students

(c) Number of students (Headcount including full and part-time students)

(d) Number of staff employees

(e) Number of faculty employees

(f) Credit hours generated

(g) Contact hours generated

(h) Class registration in the courses

(i) Square feet floor space

(j) Square feet hours floor space

There are usually two basic plans of allocating overhead and joint costs. These are described below:

(a) Primary Use Plan. According to this method, each departmentalized unit of implementary expenses should be distributed on the basis of what best reflects correct expenditure of time, effort and expense among the line department. The basic idea underlying this method

is to allocate overhead and joint costs directly among instructional programs which best portrays the user of the indirect auxiliary and supportive services.

(b) Progressive Primary Use Plan. Under this method, the indirect expenses are allocated in steps till these eventually get prorated among various instructional programs.

Which of the two plans discussed above is better? The author feels that the progressive primary use plan is better than primary use plan as it results in an equitable allocation of overhead and joint costs among instructional programs.

Which is the best basis for allocating overhead and joint costs? There is no best answer to this. Obviously a different basis should be used for allocating different overhead and joint costs. For example, the overhead at the departmental level could be allocated by the number of faculty employees. The overhead for payroll accounting at the district level could be allocated on the basis of full time employees (both faculty and staff). It was proposed earlier that the allocation procedures and basis for establishing societal costs per student by program should be mutually agreed upon by various districts.

Implicit Costs of Education

Besides the selection of the unit for determining educational costs and the allocation of the overhead and joint costs, there is also controversy among researchers and theoreticians to include or exclude some of the implicit costs of education, including opportunity costs or foregone income of the students, foregone income from the educational resources and foregone property and sales taxes. Economists argue that opportunity

costs measure the real costs of education and all educational costs should be measured as such. The concept of opportunity costs was defined as "What-is-put-in versus what-is-foregone." A few dimensions to be considered to make the concept of opportunity costs operational include the following:

(a) Who bears the cost; that is, whose foregone alternatives were being considered -- individual, family, government, or society.

(b) The time dimension of the foregone opportunities.

(c) Uncertainty dimension of the foregone opportunities.

(d) Institutional constraints; e.g., due to legal restrictions, children below a certain age may not enter labor market, and as such their opportunity cost of attending the school would be zero.

Computation of Certain Costs

Methodology of computing certain costs, like opportunity costs of students, may pose serious problems. For example, if all students were to leave the education system and join the labor market, most likely the wage rate would decline due to the operation of the law of demand and supply. What would be the opportunity cost or the foregone earnings of the student under this hypothetical condition? Should the effect of decline in wage rate of other workers in the labor market be included or excluded? These are very hard questions to answer. The general guidelines to resolve these issues should require consideration of such factors as sensitivity analysis, costs of wrong decisions and the costs and the utility of collecting such information.

The books of accounts seldom have inforamtion regarding marginal and incremental costs, which may be very vital for certain decisions and policy situations. It could be that accounting data are more or

less always based on costs incurred in the past. Marginal or incremental costs are future expected out-of-pocket costs and the past data may be of no use. Past data at the most may reflect cost trends; and if the policy or decision situation was in-ependent of the past cost trends, the past data would be of little use.

Choice of Interest Rates

A review of literature revealed that there was a great deal of controversy regarding the choice of appropriate interest rates to be used for computing the annual capital costs. This controversy perhaps could be again resolved by keeping in mind as to from which viewpoint the costs were determined. If the costs were determined for society, the return of the interest rate which society could obtain by investing educational resources elsewhere should perhaps be included. The determination of such an interest rate may not be an easy task, as different types of investments bring different return or interest rates. In vestments with greater risks are usually associated with higher returns and vice versa. What will be the preferences of the society in investing educational resources in alternative investments? Will it prefer risky or safe investments? Theoretically there may not be a way to express societal or even group preferences.

General guidelines to resolve these issues may be the magnitude of the dollar value of such costs and sensitivity analysis by using various interest rates. For the purpose of determining societal costs, the interest rate to be used should perhaps be the one at which the money could be raised at a given time plus the foregone taxes due to the interest on the bonds being a non-taxable income.

METHODOLOGY FOR ESTABLISHING COST FUNCTIONS OF EDUCATION

The establishing of costs functions of education involves the following procedures:

1. Identification of outputs of education, establishing units of measurements of outputs of education, and measuring the outputs of education represents the first step.

2. Identification of inputs of education, establishing units of measuring the inputs of education, and measuring the imputs of education constitute the second.

3. Identification of relevant costs to be measured, establishing procedures for costing the inputs and measuring the cost of inputs of education come next.

4. Establishing statistical relationships between the costs measured in step 3 above the outputs measured in step 1 on the preceding page conclude the procedure.

The procedures mentioned in one and two form the basis for establishing production functions of education. Procedure 3 regarding idnetification of relevant cost and procedures for costing various inputs of education was discussed in this chapter in an earlier section. This section, therefore, deals primarily with procedures regarding the establishment of statistical relationships between the costs and outputs of education.

The statistical relationships between costs and outputs of education may depend primarily upon the use for which the cost functions were required. As discussed earlier, some of the primary uses of cost functions may be to predict future costs required for short or long range planning

or budgeting, which again could be on a short or long run basis. It might be said that the statistical relationships between the costs and the outputs of education should be established keeping in mind the ultimate use to which cost functions may be employed.

Another use of cost functions may be to establish relationships between the production function and the marginal productivity of various input factors of education. Marginal productivity of an input factor may be defined as the contribution of the marginal input factor toward the production of outputs of education. It is conceivable that there may be situations in education where the production functions remain unchanged but the cost functions may change primarily due to the market structure. The study of relationships between the marginal productivity of various input factors may help in optimization problems which may be primarily directed at designing the educational system in such a way that the maximum output was obtained at the minimal cost.

Establishing cost functions in education may also be motivation to study the relationships between production functions and cost functions, assuming that no fluctuations in the market prices of various educational input factors have taken place but that a technical change occurred in the educational processes. Since the cost functions are more often derived from the production functions, the fiscal implications of the change of production functions will be reflected in the cost functions of education.

The cost functions of education can also be used to study the economies of scale in education. The total cost curves giving a relationship between the outputs of education and the dollar costs may help draw inferences regarding the existence or non-existence of economies of scale in education. A knowledge of economies of scale in education may help in such decisions as the

optimal size of the school, the expansion or contraction of existing programs, and the location of schools.

Cost functions of education may be established by using such statistical techniques as regression analysis. Such cost functions can be linear or curve linear.

The data used for establishing cost functions may be either the time series or cross sectional data. The time series data obtained for a program should be fairly representative of the present and expected future market condition and the productions functions. Alternative trend variables may be introduced to take care of such changes. The cross sectional data should again be obtained for relatively similar educational conditions and production functions. As far as possible, the costing procedures for costing various inputs of education should be the same to avoid bias in the data. There may be some problems in establishing cost functions of education. A discussion of some of these problems follows.

PROBLEMS ASSOCIATED WITH ESTABLISHING COST FUNCTIONS OF EDUCATION

Some of the major problems associated with establishing cost functions of education are discussed below:

1. Non-availability of cost data.

Perhaps the most complex problem in establishing cost functions of various educational programs may be the non-availability of relevant cost data required for the purpose of investigation. This problem may be due to the fact that the accounting system in the past did not require costs to be recorded by various activities or programs of the educational system. The current emphasis on

program, planning and budgeting system may improve this situation.

Any attempt to recast the past data by educational programs may introduce bias and distortions in cost functions due to the inadequacies of past data.

2. Statistical treatment of past cost data.

The prices of input factors may have changed from time to time in response to influences other than the outputs of education. The theory of the cost curves, however, assumes that the factor prices are constant and as such the fluctuations of the input prices may violate this basic assumption. This problem may be released by deflating the actual input prices by their factor price index number.

3. Regression fallacies.

The outputs of education based either on time series or cross section output data may be random in nature. The cost curves or functions based on relationships between random outputs and costs may not be very useful for predicting cost curves of the future for the purpose of decision making. This problem may be resolved by verifying the randomness in output by using such statistical tests as run tests.

4. Arbitrary costing procedures in cross section cost data.

Procedures of costing various educational programs in cross section data may not be uniform. This is especially true in the case of joint costs which have been arbitrarily allocated to various educational programs by using different bases. This problem may not be very serious if the joint costs constituted an insignificant portion of the total costs.

5. Programs -- relationships.

Educational institutes are multi-product institutes or, in other words, they produce various types of outputs or graduates of various programs simultaneously. A question may be posed as to what extent the costs of a specific program depend not only on the output of that program but also on the concurrent output of other related programs. This problem may be tackled by establishing regression equations which express relationships between the costs and outputs of not only the program for which cost functions are being established, but also the outputs of other related programs.

SUMMARY

There may be various problems in establishing cost functions of education. The most serious problem may be the lack of appropriate cost data. The other problems referred to above may not be peculiar to education alone as similar problems do exist in business and industry as well.

Some important cost concepts and uses of cost information in education have been discussed. Generalized procedures for costing various resource inputs of education primarily for the purposes of establishing unit cost and other cost related problems have been discussed. Major problems in costing resource inputs of education have been pointed out and methodology for establishing cost functions and the related problems have been described.

CHAPTER III

SOCIETAL BENEFITS OF VOCATIONAL PROGRAMS

INTRODUCTION

Chapter II dealt with the societal costs of vocational and manpower programs. The societal cost-benefit analysis of vocational programs requires an analysis of the societal benefits of vocational programs as well. This chapter deals with the identification and measurement of the societal benefits of vocational programs.

An identification of the societal benefits of vocational programs should preferably be done in the context of the goals and objectives of these programs as laid down by federal and state legislatures. Some of the important goals of vocational and manpower programs are to meet manpower needs of the society by producing graduates having salable skills; to contribute to the reduction of unemployment; to improve the economic status of such groups as disadvantaged and handicapped, leading to equitable distribution of national wealth; to promote economic growth and stability; to provide equality of opportunities for individual fulfillment; and in some cases to reduce social tensions.

The measurement of societal benefits of vocational and manpower programs is more difficult than the measurement of societal costs of such programs. The main reason for this is that most of the societal economic benefits cannot be measured directly in dollars and as such, proxy measures have to be developed which are amenable to quantification

in dollars. As an example, reduction of unemployment as a result of vocational programs could be measured indirectly through the increased gross national product which is expressed in dollars. An attempt has been made to develop devices to measure economic benefits to society as a result of vocational programs. The measurement of non-economic societal benefits of vocational and manpower programs, including social-cultural and political, were not considered; as this study was primarily concerned with cost-benefit analysis of vocational programs rather than cost-effectiveness analysis.

Finally, some of the conceptual and methodological issues in establishing societal benefits have been brought to the attention of the readers. It was felt that this would make the readers aware of some of the problems in this area.

A. BASIC CONCEPTS AND DEFINITIONS AS APPLIED TO SOCIETAL BENEFITS OF VOCATIONAL PROGRAMS

Some basic concepts and definitions as applied to the societal benefits of vocational education programs have been discussed in this section. Understanding these concepts will lead to better understanding of the procedures for establishing and measuring societal benefits of vocational education.

(1) Direct and Indirect Societal Benefits of Vocational Education

The direct societal benefit or impact of a vocational education program is defined as one which can be directly associated with a vocational program. As an example, one of the direct benefits of a vocational program could be the employability of the graduate of such a program. Another direct benefit of vocational programs could be the

increased productivity of the graduates due to the knowledge, skills and attitudes learned during their training period.

The indirect societal benefit or impact of vocational education is defined as one which is indirectly associated with vocational programs. Indirect societal benefits are also referred to as spillover impacts or externalities. Indirect impacts or externalities either confer gain on someone in society without demanding payment for it, or inflict harm on someone without compensating for it. An example of an indirect benefit is that of a student in a vocational program who, upon graduation, starts working in a steel industry. He directly contributes to the production of steel (direct benefit to the steel industry), which in turn promotes production in other industries, such as automobiles, appliances, etc. (indirect benefit to the steel user industries). An example of an indirect harmful impact of a vocational education program could be that of a student who, upon graduation, displaces another employed worker. A comprehensive analysis of societal benefits should attribute a value to such externalities. It may be mentioned that societal costs also have externalities built into them. For example, the operation of a school system may impose a burden of maintaining extra police or fire-fighting personnel in the community. The cost of such services provided by society due to the operation of an educational system are externalities. When societal benefits include externalities, societal costs should also include externalities in order to have a balanced analysis of the benefits and cost of vocational programs.

(2) Monetary and Non-Monetary Societal Benefits.

Monetary benefits are defined as those benefits where money can be

used as a direct or proxy unit of measurement. Most direct and indirect economic societal benefits are measurable in dollars. For example, the increased earnings of graduates of vocational education could be measured in dollars.

Non-monetary benefits are those benefits where money cannot be used as a direct or proxy unit of measurement of such benefits. Most social-cultural and political benefits of vocational programs defy the use of dollars as a direct or proxy unit of measurement of such benefits. As an example, if it is assumed that the voting behavior of vocational graduates improves as a result of vocational education; perhaps it will be inappropriate to use dollars directly or indirectly to measure the change in voting behavior. A comprehensive analysis of benefits of vocational programs should include such non-monetary benefits. However, it should be pointed out that benefit-cost analysis only includes those benefits which can be directly or indirectly measured in dollars. Cost-effectiveness or cost-utility analysis does include both monetary and non-monetary benefits and costs.

(3) Average and Marginal Societal Benefits.

Average societal benefits are computed by dividing the sum of the total societal benefits by the total number of recipients in a society who get such benefits. For example, if the total benefits of extra earning to a group of 20 graduates resulted in an extra earning of $20,000 during the first year of their employment, the average benefit per graduate during the first year is $1,000.

The marginal societal benefits are defined as the benefits derived by the marginal unit of the production of a vocational program. As an

example, let us assume that there were 20 graduates who upon being employed had an extra income of $20,000 during the first year of their employment. If there were 21 graduates available instead of 20 (their wage rate is assumed to have declined), it would result in an extra income of $20,900 for all the 21 graduates, the marginal benefit would be $900 ($20,900-$20,000). Thus, the marginal societal benefits may not be the same as the average societal benefits.

The difference between the marginal and incremental societal benefits is that the marginal benefits consider the extra societal benefits accrued as a result of producing one more graduate; the incremental benefits consider the extra societal benefits resulting from the production of more than one graduate of a vocational program.

(4) Private, Governmental, and Societal Benefits.

Private benefits are defined as those benefits which accrue to individuals as a result of vocational education. For example, the extra earnings as a result of vocational education could be seen strictly from the vocational graduates point of view. The extra net income (take-home pay) as a result of vocational education will represent the benefits to the graduates of such a program.

Governmental benefits are defined as those benefits which accrue to the government. For example, the extra taxes paid by vocational graduates as a result of extra earnings due to vocational education are governmental benefits. Further, governmental benefits could be looked at from local, state, and federal governments points of view. The extra taxes paid to the local, state, and federal governments by

the vocational graduates due to extra earning as a result of vocational education would represent the benefits to different governments.

Societal benefits are those benefits which accrue to society. As an example, the skills, knowledge and attitudes of the vocational schools graduates help in promoting the welfare of society in so far as these lead to the employability of the graduates. The gross national product could be used as a proxy measure of the economic welfare of society. Thus, the vocational graduates contribute to the gross national product by being employed after graduation. The contribution of the graduates in the gross national product could be measured through the extra gross income earned by them as a result of vocational education. It will be noted that gross income rather than net income or take-home pay has been used in measuring societal benefits.

It is important to keep in mind whose benefit-cost analysis of a vocational program is being done. The concept of private, governmental and societal costs and benefits not only help in this direction, but also help in deciding the inclusion or exclusion of certain costs or benefits.

(5) Present Value of Societal Benefits.

Many economic societal benefits (measured in dollars) of vocational programs accrue over several years. Because today's appraisal of the value of these benefits depends on when in the future these benefits will accrue, it is important that a consistent method of accounting these benefits be used. The procedure commonly used to account for the effect of time on the future values of benefits is called discounting. Through discounting procedures, all future benefits are changed into dollars of present worth. For example, if it is expected that the extra gross

income of a graduate as a result of a vocational program during the first year will be $1,100 and $1,331 during the second year, the present value of the benefit at 10 percent interest rate is $1,000 for the first year and $1,100 for the second year. A formula has been used to change the future value of the benefits to the present value. This will be discussed in subsequent sctions.

(6) Joint Benefits.

Joint benefits are defined as those benefits which accrue to society as a result of a number of variables operating concurrently in the creation of societal benefits. For example, the extra gross income earned by the graduates of a vocational program could be due not only to vocational education but also due to such factors as on-the-job experience, motivation on the part of the graduates to advance, and so on. In order to determine the benefits to society due to vocational education alone, the impact of other factors should be separated. This could be achieved through factor analysis.

B. PROCEDURES FOR ESTABLISHING SOCIETAL BENEFITS OF VOCATIONAL PROGRAMS

The establishing of societal benefits of vocational programs basically involves the following steps:

1. Identify societal benefits (direct monetary and non-monetary; indirect monetary and non-monetary).
2. Establish units of measurement for identified societal benefits.
3. Measure the societal benefits.
4. Analyze data regarding measured societal benefits.

The above procedural steps for establishing societal benefits of vocational programs are discussed in details in the following sections C, D and E.

C. IDENTIFICATION OF SOCIETAL BENEFITS OF VOCATIONAL EDUCATION

The societal benefits of vocational education programs could be classified in three broad categories: namely, economic, social-cultural and political. The economic benefits are defined as those societal benefits which can be directly or indirectly measured in dollars. Social and cultural benefits are those societal benefits which have social and cultural impacts upon society and cannot be measured in monetary units. Political benefits are defined as those societal benefits which have a bearing upon the political and civic affairs of the society and are not amenable to measurement in monetary units.

The economic benefits to society of vocational programs are listed below:

1. Benefits to the economy.
2. Employment benefits.
3. Reduction in welfare payment benefit.
4. Equitable income distribution benefit.
5. Reduction in crime benefit.
6. Mobility benefits.
7. Intergeneration education benefits.

Some of the social and cultural benefits to the society of vocational programs are listed below:

1. Self-esteem of graduates.
2. Improved family relations
3. Improved neighbor relations.
4. Improved cultural activities.
5. Appreciation of art.

Some of the political benefits to society of vocational programs are listed below:

1. Improved voting behavior.
2. Participation in civic and community affairs.
3. Increased awareness of the political problems of society.

The measurement of economic societal benefits as a result of the vocational and manpower programs are discussed in detail in the following sections D and E. The measurement of social-cultural and political benefits have been left out as this manual deals with the societal cost-benefit analysis rather than societal cost-effectiveness or cost-utility analysis of vocational programs.

It may be appropriate to explain the difference and commonalities among cost-benefit, cost-effectiveness and cost-utility studies of vocational and manpower program. All of the above mentioned studies are concerned with costs which are expressed in dollars. Thus, the determination of societal costs expressed in dollars is a common factor among these studies. The major difference among the studies lies in their concern for the impacts on the vocational and manpower program. The cost-benefit studies are concerned with only those impacts (benefits) which can be directly or indirectly measured in dollars. Cost-effectiveness studies are concerned with measuring the impacts which can be measured in monetary and non-monetary units. Cost-effectiveness is primarily done in the context of the goals and objectives of an educational program. Obviously some of these goals are measurable in dollars, but some of the goals, like satisfaction of the student and employer, are not amenable to measurement in monetary units. Thus, cost-effectiveness studies are

very valuable in evaluating educational programs, in so far as they indicate whether the goals and objectives were actually realized. The cost-utility studies try to convert the monetary and non-monetary impacts of educational programs into a single impact called utility. This is achieved by assigning weights to different impacts and converting them into a single scale called utility.

Fortunately, vocational and manpower programs are amenable to cost-benefit analysis. The major reason is that most vocational and manpower programs have societal impacts which can be directly or indirectly measured in money. In other words, vocational and manpower programs have the potential to justify themselves economically.

D. MEASUREMENT OF SOCIETAL ECONOMIC BENEFITS OF VOCATIONAL PROGRAMS

It was said earlier that the measurement of societal economic benefits of vocational programs is more complicated than the measurement of societal costs of such programs. The reason for the complexity is that in the measurement of societal costs of vocational education, there is a direct and explicit measure of dollars for the societal resources used in the educational system. The societal economic benefits are not only multi-dimensional in nature, but they also possess characteristics which make them less susceptible to the direct measurement in monetary units. The multi-dimensionality of societal economic benefits was shown by the list of such benefits in the preceding section. Some of the societal economic benefits included in this list were benefits to the economy and income redistribution benefits. Only proxy measures can be used for such societal economic benefits. A discussion of various societal economic benefits and their measurement follows.

1. Benefits to the Economy of Society

We are living at a time when technology is changing very rapidly. As a result many skills learned in vocational education programs become obsolete. Workers laid off as a result of the obsolescence of their skills are rehired only if they update their skills. The function of vocational programs is not only to retrain such workers, but also to meet the societal manpower needs by training young men and women for entry level jobs in the world of work. Thus, graduates of the vocational programs do promote the economic welfare of society in so far as they provide the needed skilled manpower required by business, industry and government.

Another way of looking at the benefit to the economy is that some of the societal resources would not be used due to the non-availability of skilled manpower which converts raw and intermediate goods into finished consumer and capital goods. Further, some of the services provided by such professions as nursing would not be available to the society if vocational schools were not producing graduates to meet the manpower needs in service occupations. Thus, vocational schools help in meeting the economic needs of the society.

Vocational schools also promote the economic growth and stability of society. Programs to retrain workers whose skills have become obsolete result in improving the productivity of business, industry and social sectors. Programs to train young workers for entry level jobs result in minimal on-the-job training in business, industry, and social enterprises. Thus, society enjoys economic growth and stability as a result of the vocational programs.

How are societal benefits measured in relation to the economy as a result of vocational programs? There is no direct measurement for establishing the benefits of vocational programs to the economy. These benefits include meeting manpower needs, increased utilization of resources to meet consumer needs, increased productivity leading to growth and stability and helping in achieving balance of payments through export of goods and services. A proxy measure needs to be developed to determine the heterogenous societal benefits to the economy as a result of vocational education programs.

One commonly used measure to establish the state of the economy is the gross national product (G.N.P.) which is defined as the value of all the goods and services produced by the nation during a year. Literally hundreds of thousands of different kinds of goods and services are produced annually by a nation. Each good or service is assigned relative importance or value, given by price. In other words, each good or service is multiplied by its price and the resultant dollar values total G.N.P. When prices change, the values or weights assigned to various goods and services will also change. In order to remedy this situation, the effects of changes in prices are adjusted first, so that the real increase or decrease in the output of goods and services could be measured accurately. The way economists adjust for changes in prices is conceptually very simple but operationally quite difficult. Each year the value of each kind of output is expressed in terms of the prices prevailing in some base year. The result is a series of G.N.P. values for various years in constant dollars. Constant dollar G.N.P. which is called "deflated G.N.P." reflects changes in real output from year to year.

Two approaches to measuring G.N.P. are used: The first approach consists of adding the final values of goods and services produced by the nation. The second approach aims at adding the income generated in each industry or service. Both approaches attempt to avoid double counting.

How does the concept of G.N.P. (a measuring device for the growth of economy) help in assessing societal benefits to the economy as a result of vocational programs? It was mentioned earlier that the skilled manpower produced by vocational schools does help in increasing the production of goods and services. To measure the increased contribution due to services provided by vocational graduates, the value of such services need to be measured. However, the increased production of goods could be due to several factors such as utilization of improved equipment, better raw materials, or better managerial skills. The contribution of vocational graduates in the increased production of goods could be indirectly measured through the gross wages paid to the graduates. The rationale for this is that gross wages, according to economists, reflect the productivity or contribution of the labor force in the production of goods. Thus, the gross wages earned by vocational graduates could be used to measure the societal benefits to the economy.

One problem in using gross wages to measure the societal economic benefits is that it will lead to the exclusion of services which are not marketed or sold by the vocational graduates. This is illustrated by the following examples: In the case of some home economics programs

which lead to the production of better housewives, according to economists, the improved services of housewives rendered to their families are not counted in G.N.P., as these services are not marketed. Further, in the case of a carpentry program where a student upon graduation works in a cabinet shop but uses his leisure time to make furniture for his own use, only the gross wages earned in the cabinet shop should be counted in G.N.P., and the leisure time activity of making his own furniture should be excluded from G.N.P. The rationale behind the thinking of the economists is that G.N.P. as a national accounting device was created to measure economic output only. There are a few cases where this rule of testing the output as production for market only is relaxed. The farmer's consumption of feed grown on his own farm is an example. The most important exception relates to owner-occupied homes. In the United States, 60 percent of homes are owned by the occupants, and 40 percent are rented from the landlords. It would be basically wrong to include the rental income only in G.N.P. and exclude the rental value accrued by the owners to themsleves. Consequently G.N.P. includes an estimate of the rental value of owner-occupied housing.

If one were to go strictly by the accounting principles of G.N.P., the benefits accrued to the economy as a result of non-marketing of the outputs of the graduates would be excluded. This would lead to an understatement of economic benefits of some vocational programs like home-making which may not lead to employment. The author believes in being consistent with the accounting rules of G.N.P. The

rationale behind this is that every educational program does not have to justify itself based on its economics. There are lots of societal programs which are conducted due to non-economic or humanitarian reasons. For example, programs to rehabilitate mentally retarded persons may not be justified economically, but may be assigned top priority due to humane considerations.

Sine we are interested in establishing the societal beneifts to the economy of a vocational program, the extra gross wages earned due to the training program could be considered in assessing impacts of such a program on the economy. This is illustrated by a hypothetical example.

Example 1 (Societal Benefits To The Economy As A Result Of Vocational Programs).

The students of a machine shop program in a post-secondary vocational technical institute upon graduation were employed as machinists in industry. The gross wages earned by them for eight years including fringe benefits are given below:

Student Number	Gross Wages Including Fringe Benefits During Years							
	1	2	3	4	5	6	7	8
1	$ 7,500	8,000	8,500	9,000	9,500	10,000	10,500	11,000
2	$ 7,000	7,500	8,000	8,500	9,000	9,500	10,000	10,500
3	$ 7,300	8,000	8,700	9,400	10,100	10,800	11,500	12,000
4	$ 6,500	7,100	7,700	8,300	8,900	9,500	10,100	10,900
5	$ 7,200	7,900	8,600	9,300	10,000	10,700	11,400	12,100
Total Gross Wages	$35,500	38,500	41,500	44,500	47,500	50,500	53,500	56,500

The machine shop program students at the time of their entry in the program were matched on a one-to-one basis with secondary school graduates who did not go to post-secondary education. The matching was done by comparing the socio-economic and the educational characteristics of the students. The gross wages including fringe benefits earned by secondary school graduates for the same years are given below:

Student Number	Gross Wages Including Fringe Benefits During Years							
	1	2	3	4	5	6	7	8
1	$ 6,000	6,300	6,600	6,900	7,200	7,500	7,800	8,100
2	$ 5,800	6,000	6,200	6,400	6,600	6,800	7,000	7,200
3	$ 5,900	6,250	6,600	6,950	7,300	7,650	8,000	8,350
4	$ 5,500	5,800	6,100	6,400	6,700	7,000	7,300	7,600
5	$ 6,000	6,400	6,800	7,200	7,600	8,000	8,400	8,800
Total Gross Wages	$29,200	$30,750	$32,300	$33,850	$35,400	$36,950	$38,500	$40,050

Find the societal benefits of the machine shop program per student to the economy for each of the eight years and also the average benefit for the entire eight years.

Solution To Example 1

The extra gross wages earned by machine shop graduates over the secondary school graduates during the first year of their employment is $6,300. This is computed by substracting the total gross wages earned by secondary school graduates ($29,200) from the total gross wages earned by post-secondary machine shop graduates. Thus, the difference of $6,300 could be attributed to the machine shop vocational program. The benefit to economy per student is $1,260. The benefits to economy for the next seven years are shown on the next page.

YEAR		2	3	4	5	6	7	8
Total Machine Shop Gross Wages	$	38,500	41,500	44,500	47,500	50,500	53,500	56,500
Total Secondary Graduates Gross Wage	$	30,750	32,300	33,850	35,400	36,950	38,500	40,050
Difference Between Gross Wages	$	7,750	9,200	10,650	12,100	13,550	15,000	16,450
Number of Students		5	5	5	5	5	5	5
Average Benefit to Economy	$	1,550	1,840	2,130	2,420	2,710	3,000	3,290

The average benefit to the economy per student for the entire eight years could be computed by taking the average of the averages for the eight years. This is shown below:

$$\frac{\$1260 + 1550 + 1840 + 2130 + 2420 + 2710 + 3000 + 3290}{8} = \frac{\$18,200}{8} = \$2,275$$

Comments on Example 1

It will be noted from the previous example that a control group of secondary school graduates was set up to establish the extra or differential earnings of the graduates of the machine shop program (experimental group) over the earnings of the control group. The control group should be set up early, preferably at the time of admission of the students of the experimental group in vocational programs. The social, economic, and educational characteristics of the experimental and control groups should be matched as much as possible and on a one-to-one basis. A suggested list of characteristics for matching experimental and control groups is discussed in Chapter V.

For how many years should benefits to the economy be considered as a result of a vocational program? In our example, benefits to the economy from the machine shop program are considered for eight years

only. In reality benefits to the economy may occur over longer time periods, in some cases, even over the entire working life of the graduates. What is the appropriate time period for including such benefits in the analysis? This is a very hard question to answer. The rule-of-thumb is to include the time period over which the skills learned by the graduates do not become obselete. The second approach to answer this question is to include the time period over which the average gross wages earned by the experimental and control groups become equal to each other. The second approach has been elaborated on with an example in Chapter IV.

Two types of data regarding gross wages are used to determine the benefit to economy as a result of vocational education programs. The first type of data is ex-post or historical data on gross earnings. These data will not be adequate if the benefits to the economy are assumed to accrue over the working life of the graduates. In such cases, gross wages earned by experimental and control groups will have to be estimated for the rest of their working lives. This introduces the problem of uncertainty associated with the estimates of future earnings of the experimental and control groups. The problem of uncertainty could be handled through probabilistic estimates of the future earnings. To give an example, let us assume that the estimates for the average gross earnings of a vocational program during year one were as given below:

Gross Wages	Probability
$10,000	.25
$10,500	.40
$11,000	.20
$11,500	.15

The average earnings during year one (called expected average earnings) are calculated by adding the product of the estimate of gross wages by their corresponding probabilities as shown below.

Expected average earnings = \$10,000 (.25) + \$10,500 (.40) + \$11,000 (.20) + \$11,500 (.15) = \$10,625

It should be noted that the sum of the probabilities adds to one.

Who should provide such probabilistic estimates of the future earnings of the experimental and control groups? Such estimates should be prepared by experts in the area of wage compensations. It may be mentioned in this context that a technique called DELPHI is very useful whenever a group of experts are used to predict future events. According to this technique, the experts give their estimates in successive three or four rounds, getting feedback of the results of each preceding round. The experts with extreme estimates (too high or too low) are required to either revise them conforming to the average estimates by a majority of experts, or substantiate the extreme estimates with logical reasons. Feedback of the results along with the reasoning for extreme estimates helps in improving the estimates in succeeding rounds. The average or median of the results of the last round is taken as the expert opinion of the DELPHI jury.

It may be argued that the gross wages earned by graduates of vocational programs may not be entirely due to vocational programs. There may be other factors operating which may be responsible for the earnings of the graduates. Some of the other factors affecting earnings of experimental and control groups could be on-the-job training, motiva-

tion on the part of the graduates, imperfections in the determination of wage rates such as unions, and so on. How should one separate the effects of all such variables in order to find the societal benefits to the economy due to vocational programs alone. Theoretically this can be done by using such statistical techniques as regression analysis and factor analysis. Will it serve any useful purpose? The author believes that it will not, if it is assumed that other factors are operating equally upon the experimental and control groups.

The societal costs of vocational programs are incurred during the years the students are educated in vocational institutes. The societal benefits of vocational programs accrue over the working life of the graduates. Since costs and benefits of vocational programs occur over different time periods, it is important to transform the dollar costs and benefits at a specific time period to make a meaningful comparison among them. It was mentioned earlier in this chapter that the estimated life-long dollar benefits to society could be discounted to find their present value. The process of discounting also considers the societal time value of money which was discussed in Chapter 2 in connection with the procedures for costing space inputs.

It will be recalled that in our example, the average benefit to the economy per student for the entire eight years was calculated by taking the average of the averages for eight years and was figured at $2,275. This procedure was not correct as it ignored the discounting process. The correct procedure for finding the average benefit to the economy for the entire eight years would be to find the present

value of the benefits for each year by discounting it at the societal interest rate. Assuming the societal interest rate at 5 percent compounded yearly, the present values of the benefits for each of the eight years are shown below.

Year (1)	Benefit to Economy/Machine Shop Graduate (2)	Present Worth* Factor at 5% (3)	Present Value of Benefit To Economy/Machine Shop Graduate (4) = (2) x (3)
1	$1260	.9524	$1200.02
2	1550	.9070	1405.85
3	1840	.8638	1589.39
4	2130	.8227	1752.35
5	2420	.7835	1896.07
6	2710	.7462	2022.20
7	3000	.7107	2132.10
8	3292	.6768	2228.03
TOTAL	$18,200		$14,226.01

* The values of the present worth factor at a few selected interest rates are given in Appendix A.

The total present value of the benefits to the economy for the entire eight years comes out as $14,226. Thus, the average of the benefits to the economy for an eight year period will be $1778.25 (14,266÷ 8) instead of $2,275 (18,200 ÷ 8) which was computed earlier without discounting.

It may be appropriate to explain briefly the concept underlying discounting which uses the Present Worth Factor formula. If someone gives us the option of having $1200 now or $1260 at the end of year one, which option is better for us, if our time value of money is 5 percent compounded annually? The answer is that both alternatives are equally good at 5 percent time value of money. If we get $1200 now, we could invest it at 5 percent. This would earn an interest income of $60 ($1200 x .05) during the year. So at the end of year one, we will have $1260 ($1200 +

$60). We are also getting $1260 at the end of year one as a second alternative. In other words, it could be said that the present value of $1260 at 5 percent interest rate (compounded annually) is $1200; since $1200 now is interchangeable or equivalent to $1260 at the end of year one. Similarly, the benefits to the economy for the successive years 2 to 8 have been transformed to their present values. Thus, we can say that the total benefit of $18,200 accrued over the entire eight years is equivalent to $14,226 now at 5 percent interest rate.

The numerical values of the Present Worth Factor at a few interest rates are given in Appendix A which will indicate that the numerical values of this factor decrease as interest rates increase. Thus, the use of a higher interest rate will give lower present value for the same amount at the specified future time period. This raises the question regarding appropriate interest rate to be used for discounting societal benefits. It was discussed earlier in Chapter 2 that the interest rate at which school bonds are issued should be used for costing buildings and equipment. The author believes that the bond interest rate prevailing at the time of the graduation of the students should also be used for discounting the societal benefits. The rationale for chosing the same interest rate for societal costs and benefits is that it would introduce consistency in the determination of societal costs and societal benefits.

2. Measurement of Employment Benefits of Vocational Programs

One of the primary goals of vocational and manpower programs is to produce people with salable skills. Society beneifts directly from such vocational and training programs which lead to the employment of

the trainees; society also benefits indirectly as the employment of the direct graduates of vocational programs leads to the employment of ther persons. The direct benefit resulting from the employment of the graduates of vocational and manpower programs was already included in section D (1) which related to the benefits to economy. This section deals with the indirect benefits to society which accrue as a result of the employment of the graduates.

The employment of the graduates indirectly leading to the employment of other people in business, industry and government is called a multiplier effect. This could be illustrated by an example: If during a year 11,000 students graduated from various vocational programs and 10,000 were able to get jobs in the same year, then these 10,000 graduates create jobs for other workers due to their spending and savings (spent by investors to meet societal needs). If for every 10 newly created jobs, one job is created indirectly, then the direct employment of 10,000 workers would indirectly lead to the creation of 1000 jobs. This does not stop here, as the 1000 jobs create another 100, and these 100 create another 10, which creates another one. Thus, the 10,000 jobs really led to the creation of 11,111 jobs (the indirect jobs in our case being 1,111).

The multiplier effect depends upon the state of employment and the propensity to consume on the part of the graduates and investors. It is obvious that during full employment, the multiplier effect does not operate, as everyone is already employed. However, when there is unemployment, the multiplier effect does operate. The size of the multiplier effect depends upon the propensity to spend on the part of

the graduates reflects the percentage of their income spent by them, and the propensity to save reflects the percentage of income saved by them. The savings of the graduates may be invested directly in business and industry, or may be invested indirectly through the savings and loan and other financial institutions in the society.

Should the multiplier effect of employment be included in computing the employment benefits to society of vocational and manpower programs? Very few benefit-cost studies of vocational and manpower programs have included the multiplier effect of the employment of graduates. The author believes that the multiplier effect of employment should be included in the societal benefits in order to assess the total impacts of vocational programs. The size of the multiplier effect should be established with the help of economists.

Besides the multiplier effect, there are two other effects of the employment of the graduates of the vocational programs. These are called displacement and vacuum effects. The displacement effect reflects the number of employed workers who are laid off or displaced due to the entry of graduates from vocational programs. The vacuum effect represents certain areas of employment facing shortages of skilled manpower which would never have been met but for the output of the graduates from the vocational programs.

One implication of the vacuum effect is that the entire gross earnings of the graduates of shortage skilled areas of employment should be considered as societal benefit. It will be recalled that in the preceding section only the extra gross earnings of the graduates

as a result of vocational programs were taken as a benefit to the economy. The rationale for taking the entire gross earning as a societal benefit (only in cases where vacuum effect is operating) is that jobs in the shortage skilled areas would never have been filled without the production of the graduates of vocational schools; so the opportunity societal benefit is zero.

Ideally, displacement and vacuum effects should be included in societal benefits. However, it may be pointed out that with our present state of knowledge, it is hard to estimate their magnitude. Also these effects change with a change in economic activity and technology. The cost-benefit analyst should clearly state the assumptions underlying these effects if they are included in the analysis of societal benefits.

3. Reduction in Welfare Payment Benefits

Many times welfare payments are terminated due to the employment of persons as a result of vocational and manpower programs. Thus, society benefits as a result of the vocational programs especially when these are directed towards the economically disadvantaged population of the nation. The benefit analysis of vocational programs should include the direct and indirect benefits of reduction in welfare payments. The measurement of such benefits is illustrated by a hypothetical example.

Example 2 (Reduction in welfare payment benefits)

In a metropolitan area, it was planned to offer vocational programs for 10,000 persons on welfare. The average welfare payment was $400 per month. Vocational programs for 10,000 persons led to the employment of 9,000 persons during the first year, 500 during the second year.

The welfare payment was stopped when they found employment. As a result of the reduction in the welfare recipients, the agencies administering the welfare program were able to lay off 10 persons earning average gross earning of $9,000 per year and a supervisor earning $12,000 annually. It is assumed that the skills learned by graduates of vocational programs will last for five years with a probability of 50 percent, eight years with a probability of 30 percent, and ten years with a probability of 20 percent.

Find the benefit to society per graduates as a result of the reduction in welfare payments.

Solution to Example 2.

It may be pertinent to calculate the expected period over which the reduction in welfare payments to the society will accrue. This can be achieved by multiplying the years with their corresponding probabilities as shown below.

Expected Benefit Period = 5 (.5) + 8 (.3) + 10 (.2) = 6.9 years or approximately 7 years

The average welfare payment was $400 per month or $4800 per year. The reduction in welfare benefits to the 9,000 persons who got jobs immediately after graduation will lead to a saving of $43.2 million per year ($4,800 x 9,000) for seven years. The present value of these benefits for seven years at 5 percent compounded yearly comes out as $249.95 million. The reduction in welfare payments to 500 persons who got jobs during the second year after graduation comes out as $2.4 million ($4,800 x 500) per year and accrues from two to year seven. The present value of reduction in welfare payments was calculated at $11.61 million. Summarizing, the sum of present

value of benefits to 9,000 and 500 persons is shown below.

Present value of benefits due to reduction in welfare payments to 9,000 persons = $249.96 (million)

Present value of benefits due to reduction in welfare payments to 500 persons = $ 11.61 (million)

Sum of present value of benefits due to reduction in welfare payments to 9,500 persons = $261.57 (million)

The total benefit of $261.57 million was a direct benefit due to a reduction in welfare payments. There are some indirect benefits due to the reduction in the staffing of the welfare agency. The savings to society as a result of 11 persons laid off is equal to $102,000 ($9,000 x 10 + $12,000 x 1) per year for seven years. The present value of such indirect savings to the society as a result of reduction of persons on welfare roll comes at as $.59 million at 5 percent interest compounded yearly. The direct and indirect savings thus amount to $262.16 million ($261.75 million + $.59 million). The present value of direct and indirect benefits due to the reduction in welfare payment per graduate comes out as $26,216 ($262.16 million ÷ 10,000). It should be noted the present value of benefit calculated at $26,216 per graduate is the benefit for the entire seven year period. Also it will be seen that the total benefit of $262.16 million has been divided by 10,000 rather than 9,500. This is due to the fact that in our example the vocational program was started for 10,000 persons.

4 Equitable Income Distribution Benefit of Vocational Programs

The employment of graduates of vocational and manpower programs leads to a reduction of economic dependency of those who were previously on the welfare rolls. This benefit was discussed in the preceding section D-3. Besides the reduction of welfare payments, voca-

tional and manpower programs lead to more equitable distribution of national wealth in tune with societal values. Thus, this benefit of equitable distribution of national wealth accrues not only to the recipients of the welfare, but also to the non-recipients of welfare benefits, who upon graduation are able to get jobs in business, industry and services.

How are societal benefits of equitable distribution of national wealth due to vocational and manpower programs measured? This is discussed below.

The utility of money varies from person to person depending on his economic needs, value system, family size, and so on. However, according to economists money has higher utility for low or middle income persons as compared to high income persons. The rationale behind their thinking is that money earned by low or middle income persons enables them to meet their pressing basic economic needs. The money earned by high income persons enables them to meet both basic and higher order economic needs.

We may measure the equitable income distribution benefit of vocational and manpower programs by assigning different weights to the extra gross income earned by different economic groups as a result of vocational education. As an example, a weight of four could be assigned to the first $1000 gross income, a weight of three to the next extra $1000 gross income, and so on. The scheme of assigning different weights to the different extra gross income earned by different economic groups as a result of vocational programs would reflect the distribution or equity benefits to the society as a result of vocational education.

The question arises, what weights should be assigned to different incremental gross earnings earned by different economic groups. It is

not easy to answer this question as it is difficult to measure operationally the utility of money to different economic groups in society. The author believes that the scheme of assigning weights should be mutually agreed upon by the concerned parties, so that uniform procedures are used for assessing the benefits of all vocational programs in the state of Wisconsin.

5. Reduction In Crime Benefits

It has been hypothesized by educators and sociologists that educational programs lead to a reduction in the crime rate especially among youth. If this hypothesis is true, society gains economically due to vocational programs leading to the reduction of the crime rate. The indirect economic benefit to society as a result of crime reduction should be included in the benefit analysis. The measurement of such benefits is illustrated by a hypothetical example.

Example 3 (Reduction In Crime Benefit).

Vocational programs in a metropolitan area produced 10,000 graduates in a certain year. It was estimated that the skills learned by them will become obsolete in 10 years. The number of all types of crimes to be committed by the graduates (experimental group) were estimated as shown below:

Number of Crimes Per Year	Probability
300	.30
400	.50
500	.20

The average expected direct cost to society for each crime has been estimated at $500 from the national data. The average expected indirect

cost to the society for each crime is $100. The indirect cost includes the cost of law enforcement personnel, courts, jails, etc.

A control group of 10,000 youth having the same characteristics as vocational school graduates at the time of entry to vocational schools was formed. The number of all types of crimes to be committed by the control group were estimated as below:

Number of Crimes Per Year	Probability
500	.30
600	.50
700	.20

Find the annual average benefit to society as a result of crime reduction due to vocational education programs.

Solution To Example 3

The expected number of crimes per year by the experimental and control groups are obtained by multiplying the number of crimes by their corresponding probabilities as shown below.

Expected number of crimes (experimental group)=(300 x .2) + (400 x .5) + 500 (.2) = 60 + 200 + 100 = 360

Expected number of crimes (control group) = 500 (.3) + 600 (.5) + (700 x .2)=150 + 300 + 140= 590

Expected Reduction in crimes due to vocational education = 590 - 360 = 230

Direct and indirect benefits to society per crime = $500 + 100 = $600

Expected societal benefit as a result of crime reduction = $600 x 230 = $138,000

Expected societal benefit per student = $138,000 ÷ 10,000 = $13.80

Note: The expected societal benefit of $138,000 accrues to society per year from year one to year 10. The present value of such benefit could

be found by discounting at the social rate of interest.

Comments On Example 3

Crimes committed in society have monetary and non-monetary consequences upon the victims. For example, vandalism leading to the loss of property has both monetary and non-monetary consequences. The dollar value of the property lost (replacement cost) as a result of vandalism represents the monetary consequence to a number of society. The emotional attachment to a piece of art lost due to vandalism represents the non-monetary consequence of this crime. It was said earlier that in benefits analysis we are only concerned with the monetary consequences of crime.

It is sometimes hard to establish the monetary consequences of such crimes as murder. The best one can do in such a case is to estimate the life time gross earnings lost by a victim of such crime over the remaining actuarial working life of the victim.

There are all kinds of crime in a society from shoplifting to murder. The Department of Interior converts these crimes into a single index to reflect the crime rate from time to time. This is achieved by assigning different weights to different types of crimes. The same department also compiles the societal cost data of crime. The national data could be used to establish the benefits to society as a result of reduction in crime rate due to vocational education.

6. Mobility Benefits

The vocational and manpower programs equip graduates with skills to make them more mobile in society. If there are no jobs related to a particular trade in a certain geographical region, graduates can move to another geographical region where there is a demand for their

skills. This helps in removing structural unemployment in a society.

The concept of mobility among vocational and manpower graduates also works in another dimension. The placement of such graduates in entry level jobs enables them to advance on the career ladder as a result of on-the-job experience and other factors, like further education. In other words, graduates of vocational programs have the potential of mobility to move on a career ladder.

How should one measure the benefits to society as a result of the mobility of vocational graduates? Basically the societal economy gains as a result of the mobility of the vocational graduates. It was discussed earlier that benefits to the economy could be indirectly measured through the extra gross earning as a result of vocational programs.

Another way of looking at the mobility benefits of vocational programs is that it prolongs the life of the skills learned by vocational graduates. Since the mobility benefit is already included in the societal benefit to the economy, it should not be included again to avoid double counting.

7. Intergeneration Benefits

Intergeneration benefits are those that accrue to the children of the generation currently being educated. These benefits result because of the association between the educational attainment of the parents and children. For example, it has been estimated that a child of a parent having only an elementary education has 2.6 fewer years of education as compared to a child of a parent having a college education.[1] Thus one benefit of the vocational and

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[1]W.J. Swift and B.A. Weisbrod, "On the Monetary Value of Education's Intergeneration Effects." Journal of Political Economy, Vol LXXIII, No. 6, December, 1965.

manpower programs is that the higher education attainment level of the present generation leads to the higher education level of the future generation.

Should intergeneration benefits of a vocational program be included in the benefit analysis? Very few studies have included such intergeneration benefits. The author feels that such benefits should be excluded. Including intergeneration benefits leads to double counting the benefits of a vocational program - first counting, the expected benefits of higher education attained by future generations, and the second counting when future generations actually get higher education. The other reason for excluding intergeneration benefits is that the higher educational attainment level of future generations will perhaps be more influenced by such factors as educational requirements for various jobs, peer influence, proper guidance by counselors, etc. than the education of the parents. Further, since intergeneration benefits accrue after many years, the present value of such intergeneration benefits may not be significant.

E. COMPUTATION OF TOTAL SOCIETAL BENEFITS OF A VOCATIONAL PROGRAM PER STUDENT

The preceding section dealt with the measurement of economic benefits of vocational programs. The procedures for measuring such benefits were illustrated by hypothetical examples. Having computed each economic benefits for a vocational program, the present or annual value of such benefits may be added as shown below.

(1)	Benefits to economy per student	$
(2)	Benefits due to employment (multiplier effect only)	$
(3)	Reduction in welfare payment per student	$
(4)	Reduction in crime benefit	$
	Total benefits per student	$

It should be pointed out that dollar benefits to the economy per student of a vocational program include direct employment and mobility benefits as was discussed in the preceding sections, D-2 and D-6. If it is desired to include equitable distribution of national wealth benefits, the dollar benefits to the economy per student may be adjusted, as was discussed in section D-4.

F. A NOTE ON THE SOCIETAL BENEFITS OF ON-THE-JOB TRAINING PROGRAMS

It was said earlier in Chapter II, that resources used by business, industry, and services in training vocational programs' graduates should be treated as societal costs in spite of the fact that the educational system does not pay for the used resources. On-the-job training also results in societal benefits in so far as the trainees produce goods and services during their training period. Thus, the output of goods and services by the trainees should be included in the societal benefits.

There may be three kinds of on-the-job training. First, the trainees are not paid for the goods and services they produce during their training. Second, the trainees are paid a nominal stipend or remuneration for the production of goods and services. Third, the trainees are compensated at the regular wage rate paid by the employers to workers having the same qualifications as that of the trainees. In the third case, the gross wages earned by the trainees would reflect a benefit to the economy. The societal economic benefit in the first two cases (when trainees are not paid anything or paid nominally) should be calculated. The procedures for determining the societal benefits of programs involving on-the-job training are illustrated by a hypothetical example.

Example 4: (Societal Benefits of on-the-job training)

In a vocational district, 100 students were enrolled in a two-year nursing program. As a part of their graduation requirements, the students were to spend the last six months of their training in various hospitals. The trainees were not paid anything during their training programs but were assigned tasks which would ordinarily have been done by the regular hospital staff. The average wage rate of the regular trained staff was $600 per month. Since the trainees were not efficient in doing all the assigned tasks, the hospital could have hired less efficient employees by compensating them at $400 per month. Find the societal benefit per trainee.

Solution to Example 4

Since the hospitals would have hired staff of equal efficiency as that of trainee at $400 per month, the hospital (which is a part of society) gained or benefited at $400 per month or $2400 for six months for the services performed by the trainee. This should be included in the societal benefit analysis of nursing programs.

It should be noted that the societal benefits were computed at the hypothetical wage rate of $400 per month to be paid to employees of equal qualifications and not at $600 per month paid to the regular trained staff.

In case some nominal stipend, say of $30 per month, was paid to the trainees, the societal benefits will be the same as before, namely $400 per month or $2400 for 6 months. The expense of $30 per month paid as stipend could be treated as societal cost.

The above example illustrates the case of production of services by the trainees. Where goods are produced by the trainees, the hypothetical gross wages paid by the employer to persons with similar backgrounds as the trainees may be used to compute the societal benefits.

G. CONCEPTUAL AND METHODOLOGICAL ISSUES IN DETERMINING SOCIETAL BENEFITS OF VOCATIONAL PROGRAMS.

Readers should be aware of the conceptual and methodological issues in determining societal benefits of vocational programs. A familiarity with such issues will perhaps lead to a better appreciation of the methodological procedures suggested in this manual. A discussion of some of the issues in this area follows.

(1) It was suggested in the manual that benefits due to economic growth, employment and mobility could be measured through the extra gross income earned by the graduates due to vocational education. The gross earnings of workers in business, industry, and services are not completely determined by the law of demand and supply or marginal productivity of the workers. More often the wages of workers are determined by negotiations between the unions and the employers. Thus, the imperfections in the labor market may distort economic benefits measured through extra gross earnings due to vocational education. For example, the extra gross wages earned by workers in the construction industry, which is mostly unionized, may be more than that of the extra gross wages earned by the graduates of nursing programs, where there is a lesser degree of unionization.

(2) The gross wages earned by workers also depend upon the state of economy. During a period of economic expansion, most graduates get jobs, and wage rates may be higher especially in skill shortage areas. Thus, the economic benefits of vocatiobal programs during a period of

economic expansion may be greater than in a recession or depression period.

(3) The gross wages earned by workers also depend upon the general price index. The economic benefit to society may be greater during inflation resulting in higher gross wages than during deflation resulting in lower or stable wages. This problem could be handled by adjusting gross wages according to the base year consumers price index reflecting the real purchasing power of the gross wages.

(4) Establishing economic benefits to society often involves an estimation of the future earnings of the graduates. No estimates of the future gross wages to be earned by the graduates of vocational programs will be perfect. This is due to the fact that future gross wages earned by workers depend upon a host of factors - some of which were discussed above. The problem of estimating the future earnings of workers could be handled by probablistic estimates by a jury of experts in the area of wage compensation.

(5) The future wages earned by graduates of a vocational program may be due to motivational factors. It may be hard to measure future motivation patterns of graduates of vocational programs and their impact upon their wages.

(6) The economic benefits to society of certain vocational programs like homemaking may be underestimated due to the fact that these skills are not marketed. There may also be a considerable amount of non-market production by the graduates of such programs as

auto-repairs, carpentry, etc. The best way of handling such programs is to use cost-effectiveness cost-utility analysis, rather than cost-benefit analysis. The effectiveness or utility will include non-marketed production of the graduates of such vocational programs.

(7) It was mentioned in the preceding section D, that the determination of benefits involves the use of control groups. Ideally a control group should come from the same population as an experimental group. However, it may be difficult to match the two groups on a one-to-one basis using socio-economic-educational characteristics. Operationally a perfect matching is not possible on all characteristics. Even if a perfect matching was achieved on a one to one basis, different intervening variables may be operating during the treatment or education period of the experimental group. The practical solution to this problem is to select the experimental and control groups before treatment and to match the two groups on a one to one basis as best as one can.

(8) It may be a problem to select the proper interest rate to discount the future earnings of graduates of a vocational program. This problem was also discussed in Chapter II in connection with the measurement of societal capital costs of vocational education programs. The author believes that the interest rate used for discounting future earnings of workers should be the same as used for costing capital inputs.

(9) The problem of measuring the multiplier, displacement and vacuum effects of employment benefits to society was discussed in

section D-2. It was suggested to include multiplier effect, but exclude displacement and vacuum effects in the benefits analysis of vocational programs. These suggestions were primarily based upon practicality, as displacement and vacuum effects are very hard to measure. The problem of measuring the multiplier effect of employment were also discussed briefly.

There is a controversy regarding the inclusion of the multiplier effect on the employment of graduates of vocational programs. Some economists believe that the multiplier effect should be included only if the benefit analysis has actual-out orientation; and it should be excluded if the benefit analysis has productive-capacity orientation.[2] The author agrees with this view. Since the manual has an actual-output orientation, the inclusion of multiplier effect of employment was suggested.

A discussion of some of the conceptual and methodological issues in establishing societal economic benefits of vocational programs will make the readers aware of some of the problems in this area. If the benefit-cost analyst makes some assumptions to overcome some of the above mentioned problems, these assumptions should be stated explicitly; and also the assumptions should be in conformity with the real world situation.

SUMMARY

This chapter explained the basic concepts and definitions as applied to societal benefits of vocational programs. Having established a preliminary

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[2]See Einar Hardin, "Benefit-Cost Analyses of Occupational Training Programs: A Comparison of Recent Studies" in G.G. Somers and W.D. Wood (editors) "Cost-Benefit Analysis of Manpower Policies. Proceedings of a North American Conference". Industrial Relations Centre, Queens University, Kingston, Ontario, Canada. 1968, o,101.

foundation of various concepts of societal benefits, a generalized procedure for establishing the societal benefits of vocational education programs was discussed. These precedures include identification of societal benefits, establishing units of measurements for identified societal benefits, measuring societal benefits, and analyzing data regarding societal benefits. The identified benefits were categorized into three broad categories, namely economic, social-cultural, and political. The procedures for measuring societal benefits was restricted to economic benefits only, as the study was confined to societal cost-benefit study rather than societal cost-effectiveness or cost-utility analysis. The economic benefits to society as a result of vocational programs included benefit to economy, employment benefits, reduction in welfare payment benefits, equitable income distribution benefit, reduction in crime benefit mobility benefit, and intergeneration benefit. The procedures to measure the above mentioned economic benefits were illustrated with hypothetical examples. Finally, some of the conceptual and methodological issues in establishing societal benefits of vocational programs were discussed to make the readers aware of some of the problems in this area.

Chapter IV

ANALYSIS OF SOCIETAL COSTS AND BENEFITS OF VOCATIONAL PROGRAM

INTRODUCTION

The establishing of societal costs and benefits of vocational and manpower programs was discussed in Chapters II and III respectively. The next step after collecting the costs and benefits data of a vocational program is to analyze data related to societal costs and benefits of vocational programs. This chapter deals with the analysis of data related to costs and benefits.

This chapter discusses different methods of analyzing data related to societal costs and benefits of vocational and manpower programs. The methods are illustrated with hypothetical examples. The advantages and disadvantages of each method have been discussed briefly. Finally, a comparison among various methods has been made.

A. Methods of Analyzing Societal Costs and Benefits of Vocational Programs

There are basically five methods of analyzing data related to societal costs and benefits of vocational programs. These methods are listed below:

A. Present value of net benefits method

B. Annual Value of net benefits method

C. Rate of return method

D. Benefit-cost ratio method

E. Pay-back period method

These methods have been described in the following sections. The procedural steps used in applying the above mentioned methods have been illustrated by hypothetical examples.

1. Present Value Methods.

Under this method, all the societal costs and benefits are discounted to find their present values at the time when the training program started. If the present value of the societal benefits exceeds the present value of societal costs, it indicates that society is getting more benefits as compared to the costs incurred. The net present value of benefits (obtained as a result of the difference between the present value of benefits and present value of costs) represents the present value of the net benefits of a vocational program. The precedures involved in using this method are illustratedy by a hypothetical example.

Example 1 (Present Value Method).

A two-year vocational program in Machine Shop was costed to determine the societal costs per student. The cost data collected is shown on the next page.

First year societal costs:

1.	Direct Costs of Instruction (Faculty, equipment, space, supplies) =	$1,100
2.	Supervision at departmental level (cost per contact hour generated x contact hours in the program) = ($1.50 x 60) =	$ 90
3.	Administrative costs at school level (cost per contact hour generated x contact hours in the program) = ($2.00 x 60) =	$ 120
4.	Administrative costs at the district level (cost per contact hour generated x contact hours in the program) = ($1.00 x 60) =	$ 60
5.	Administrative cost at the state level (yearly administrative costs ÷ number of full-time equivalent students) = ($3,000,000 ÷ 60,000) =	$ 50
6.	Administrative costs at the federal level (yearly administrative costs ÷ number of full-time equivalent students in the nation) = ($120,000,000 ÷ 60,000) =	$ 40
7.	Guidance and Counseling Services (yearly guidance and counseling costs ÷ number of full-time equivalent students in the school) = ($30,000 ÷ 6000) =	$ 5
8.	Library Services (yearly library costs ÷ number of full-time equivalent students in the school) = ($120,000 ÷ 60,000) =	$ 2
9.	Student Services (Housing, Parking, etc) (yearly student services costs ÷ number of full-time equivalent students in the school) = ($600,00 ÷ 60,000) =	$ 10
10.	Other Services (Registration, audio visual, financial aids, etc.) (yearly other services costs ÷ number of full-time equivalent students in the school) = ($1,380,000 ÷ 60,000) =	$ 23
	Total direct and indirect costs for first year.	$1,500

The societal opportunity costs per student for the first year were calculated as shown below:

11.	Student Opportunity costs (enrolled in school and as such not working) =	$3,997
12.	Sales Tax lost (yearly sales tax lost on purchases ÷ number of full time equivalent students in school) = ($12,000 ÷ 6,000) =	$ 2
13.	Propoerty tax lost (yearly property tax lost ÷ number of full time equivalent students in school) = ($6000 ÷ 6000) =	$ 1
	Total societal opportunity costs =	$4,000
	Total societal direct, indirect and opportunity costs per student = ($1,500 + 4,000) =	$5,500

The costs per student during the second year of the Machine Shop program without a detailed breakdown are given below:

Direct and indirect costs of instruction	$1,600
Societal opportunity costs	$5,000
Total Costs	$6,600

The data regarding societal benefits per student as a result of the machine shop program were also collected and are discussed below:

(1) The experimental group consitiuting of 100 graduates of the Machine Shop program was to be compared with a control group of of 100 persons. The control group had more or less the same characteristics as the experimental group prior to starting the training program. However, the control group did not attend the post-secondary machine shop program and started working in business and industry after graduation from secondary schools.

(2) The average gross wages earned by the experimental group during the first year of employment were $4 per hour, and the raise in gross wages per hour was 30¢ in the succeeding years. Thus, the Machine Shop graduates earned $4.30 per hour during the second year, $4.60 per hour during the third year, and so on.

The average gross wages earned by the control group were $2 per hour during the first year of employment, and the raise in gross wages earned by the control group were $2.50 during the second year, $3.00 per hour during the third year, and so on.

(3) The employment record of the experimental group over the 6 year period was as shown below:

Number of graduates	Total years of employment out of 6 years
80	6
10	5
10	4

The employment record of the control group over the 6 years was as as shown below:

Number of graduates	Total years of employment out of 6 years
50	8
20	7
10	6
20	5

(4) Out of a total of 100 students in the experimental group, 10 were on the welfare roll. The average payment including food stamps amounted to $450 per month, or $5,400 per year. This payment was stopped as a result of their employment. The welfare students of the experimental group were able to hold their jobs for the entire 6 years.

The control group also had 10 persons on welfare out of a total of 100. The employment records of this group were different. Out of a total of 10 persons, five were able to hold jobs for 6 years, and the other five were able to hold jobs for 5 years. Whenever they were not employed, they went back on the welfare roll.

(5) The data regarding crimes involving monetary losses to the society were also collected for the experimental and control group for 8 years.

Experimental Group

Type of Crimes	Number of Crimes/Year	Average Societal Loss per Crime
A	15	$500
B	10	$2000
C	5	$2500

Control Group

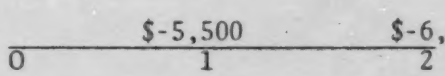
Type of Crimes	Number of Crimes/Year	Average Societal Loss per Crime
A	20	$500
B	15	$2000
C	10	$2500
D	5	$5000

Find the present values of the societal costs and societal benefits per student of the machine shop program from the above data. Make necessary assumptions whenever the above data are considered as inadequate. Find the net present value of societal benefits. The societal time value of money is 5 percent compounded yearly.

Solution to Example 1.

The societal costs of the experimental group (direct, indirect, and opportunity costs) during years 1 and 2 could be shown on a cash flow diagram which is a device of indicating the outflow (societal costs) and inflows (societal benefits) of money. The basic assumption underlying the cash flow diagrams is that the costs or benefits for a period are treated as the period end costs or benefits. The period depends upon the compounding factor associated with the societal time value of money. For example, if the societal time value of money is 5 percent compounded yearly, the period is a year; if the societal time value of money is 5 percent compounded quarterly, the period is a quarter or 3 months, and so on.

The societal time value of money in our example was 5 percent compounded yearly. So the period for our cash flow diagram will be a year. The societal costs of the machine shop program per student (direct, indirect) and opportunity) were $5,500 during year 1 and $6,600 during year 2. The cash flow diagram will look as shown below.



The zero on the above cash flow diagram represents the present (now); 1 represents the end of year 1 and 2 represents the end of year 2, and so on. It should be noted that the societal costs of $5,500 were incurred throughout the year from time period 0 to 1. They are assumed to have been spent at the end of year 1. Similarly, $6,600 were incurred throughout year 2 (from year 1 to year 2). It is again assumed that this amount of $6,600 was spent at the end of year 2 rather than throughout the year. It will also be noted that $5,500 and $6,600 have been shown as minus figures. This is done to keep societal costs seperated from societal benefits which subsequently will be expressed with plus figures.

The present value of societal costs at time period 0, or now, could be computed by multiplying the year end societal costs by present worth formulas at 5 percent for year 1 and 2 respectively. This is shown below:

Year	Societal Costs	Present Worth Factor at 5% Compounded Yearly	Present Value of Societal Costs at Time Period 0
1	$5,500	.9524	$5,238.20
2	$6,600	.9070	$5,986.20
Total Present Value of societal costs per student			$11,224.40

The present value of societal costs of the machine shop program at 5

percent compounded yearly comes out as $11,224.40. What does it mean? It implies that at time period zero, or now, the societal costs are equal to $11,224.40. In other words, spending of $11,224.40 now is equivalent to spending $5,500 and $6,600 at the end of years 1 and 2 respectively, if the societal time value of money was 5 percent. The calculation of the present value of the societal costs was an easy task, as these were spelled out explicitly in the example. The calculation of the present value of societal benefits will involve some more work, as the data regarding such benefits have not been stated explicity. The procedures of establishing the societal benefits from the data in the example are discussed below.

(1) Calculation of benefit to the economy as a result of the machine shop program. The employment and gross wages data for the experimental and control groups could be used to calculate the benefit to the economy as a result of machine shop programs. This is shown below.

The employment record data for the experimental and control groups indicate that the members of the experimental group were able to hold jobs longer than the members of control groups. Thus, the economy benefitted due to the machine shop graduates working over a longer time period.

The benefit to the economy due to the machine shop program could be calculated during various years by finding the incremental or extra gross earnings of the machine shop graduates (experimental group) over the gross earnings of the control group. The gross wages earned by the experimental and control groups during years 1 to 8 could be calculated by multiplying the annual gross wage data with the employment data which is reproduced in

Tables 4-1 and 4-2 below.

TABLE 4-1

Experimental Group Employment Data

Number of members of experimental group (1)	Years of employment out of 6 years (2)
80	6
10	5
10	4

TABLE 4-2

Control Group Employment Data

Number of members of control group	Years of employment out of 6 years
50	8
20	7
10	6
20	5

One of the shortcomings of the data in Tables 4-1 and 4-2 is that it does not indicate the period of unemployment of the members of experimental and control groups. So some assumption will have to be made regarding the period of unemployment. Let us assume that the period of unemployment occurred during the last years. As an example, if a person was employed for 5 years, it is assumed that he was unemployed for 3 years from year 6 to year 8.

The average gross wages per hour of the experimental and control groups have been shown in Table 4-3 below.

TABLE 4-3

Gross Wages Earned Per Hour By Experimental and Control Groups

Group	Gross Wages Per Hour Earned During Years							
	1	2	3	4	5	6	7	8
Experimental ($)	-	-	4.00	4.30	4.60	4.90	5.20	5.50
Control ($)	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50
Difference ($)	(-)2.00	(-)2.50	1.00	.80	.60	.40	.20	0

The gross wages data of the experimental and control group will indicate that the machine shop graduates (experimental group) did not earn any income during years 1 and 2 since they were in the training program. The members of the experimental group started with a wage rate of $4.00 per hour and received a raise of 30¢ per hour. The control group received $2.00 per hour during the first year of their employment and due to their on-the-job experience and training received a raise of 50¢ per hour. It will be noted that the income of the experimental and control group was equalized by the end of 3 years from the start of the machine shop program.

The annual gross wages earned by the experimental and control groups could be calculated by assuming that they worked 40 hours a week for 50 weeks in a year or 2000 hours in a year. This is shown in Table 4-4 on the following page.

TABLE 4-4

Gross Wages Earned Per Year By Experimental and Contol Groups

Group	Gross Wages Earned During Years							
	1	2	3	4	5	6	7	8
Experimental ($)	-	-	8,000	8,600	9,200	8.800	10,400	11,000
Control ($)	4,000	5,000	6,000	7,000	8,000	9,000	10,000	11,000
Difference ($)	(-)4,000	(-)5,000	2,000	1,600	1,200	1,800	400	0

The total gross wages earned by the experimental and control groups during various years could be found by multiplying the number of employed workers belonging to a group with the wage rate of the group during their years of employment. The total gross wages earned by the exmperimental grcup are shown in Table 4-5.

TABLE 4-5

Total Gross Earnings of Experimental Group

Year	Total Gross Wages Earned During Years of Employment			
	80 Employed During Years 3 to 8	10 Employed During Years 3 to 7	10 Employed During Years 3 to 6	Total Earnings During Year
(1)	(2)	(3)	(4)	(5)
1	-	-	-	-
2	-	-	-	-
3	640,000	80,000	80,000	800,000
4	688,000	86,000	86,000	860,000
5	736,000	92,000	92,000	920,000
6	784,000	98,000	98,000	980,000
7	832,000	104,000	-	936,000
8	880,000	-	-	880,000
TOTAL	4,560,000	460,000	356,000	5,376,000

The data in columns (2), (3) and (4) of Table 4-5 were obtained by multiplying the annual gross wage data by the number of people during the year. Column (5) is equal to the total of columns (2), (3), and (4) and represents the total gross earnings by the experimental group during the year.

The total gross earnings by the control group were calculated the same way and are shown in Table 4-6.

TABLE 4-6

Total Gross Earnings of Control Group

Year	Total Gross Wages Earned During Years of Employment				
	50 Employed During Years 1 to 8	20 Employed During Years 1 to 7	10 Employed During Years 1 to 6	20 Employed During Years 1 to 5	Total Earnings During Year
1	$200,000	$ 80,000	$40,000	$ 80,000	$400,000
2	250,000	100,000	50,000	100,000	500,000
3	300,000	120,000	60,000	120,000	600,000
4	350,000	140,000	70,000	140,000	700,000
5	400,000	160,000	80,000	160,000	800,000
6	450,000	180,000	90,000	-	720,000
7	500,000	200,000	-	-	700,000
8	550,000	-	-	-	550,000
	$3,000,000	$980,000	$390,000	$600,000	$4,970,000

The extra gross income earned by the experimental group as compared to the income earned by the control group during years 1 to 8 represent the benefit to the economy and is shown in Table 4-7 on the following page.

TABLE 4-7

Difference Between the Experimental and Control Groups Earnings

Year	Total Gross Wages Earned During Year		Extra Gross Earnings of Experimental Group	Extra Gross Earnings Per Graduate of Experimental Group
	By Experimental Group	By Control Group		
(1)	(2)	(3)	(4)	(5)
1	$ -	$ 400,000	$(-)400,000	$(-) 4,000
2	-	500,000	(-)500,000	(-) 5,000
3	800,000	600,000	200,000	2,000
4	860,000	700,000	160,000	1,600
5	920,000	800,000	120,000	1,200
6	980,000	720,000	260,000	2,600
7	936,000	700,000	236,000	2,360
8	880,000	550,000	330,000	3,300
TOTAL	$5,376,000	$4,970,000	$ 406,000	$ 4,060

Thus, Table 4-7 above gives the benefit to the economy. The data regarding extra gross earnings per graduate of the machine shop program are shown in column (5) and were obtained by dividing the figures of column (4) by 100, as the size of the experimental group was 100. It should also be pointed out that the negative benefits of $4,000 and $5,000 during years 1 and 2 respectively were treated as societal opportunity costs and are already included in the societal costs. The benefit analysis done subsequently will ignore these minus figures of $4,000 and $5,000.

(2) Societal benefits due to reduction in welfare payment. There were ten persons each in the experimental and groups who were on welfare at the time the machine shop program started. It will be correct to assume that the experimental group received $54,000 ($5,400 x 10) during their training program or during years 1 and 2.

The control group welfare recipients received welfare payments during their periods of unemployment. Five were unemployed for 3 years (during years 6 to 8), and another 5 were unemployed for 4 years (during years 5 to 8). They received welfare payments during their periods of unemployment. The welfare payments made to the experimental and control groups during years 1 to 8 are shown in Table 4-8 below.

TABLE 4-8

Year	Welfare Payments Received By		Extra Payments To Control Groups	Extra Payment To Control Group Per Student
	Experimental Group	Control Group		
(1)	(2)	(3)	(4)	(5)
1	$54,000	$ -	$(-)54,000	$(-) 540
2	54,000	-	(-)54,000	(-) 540
3	-	-	-	-
4	-	-	-	-
5	-	27,000	27,000	270
6	-	54,000	54,000	540
7	-	54,000	54,000	540
8	-	54,000	54,000	540
TOTAL	$108,000	$189,000	$ 81,000	810

Column (2) of Table 4-8 indicates the welfare payment of $54,000 to machine shop students during years 1 and 2 or the time of their training. Column (3) indicates the welfare payments to the control group during their period of unemployment. It has been stated that 5 were unemployed for 4 years and another 5 for 3 years, which could be interpreted as 10 being unemployed for the last 3 years (years 6 to 8) and another 5 during years 4. Column

(4) shows the extra welfare payments made to the control group. The figures in column (4) were obtained by substracting the figures of column (2) from from the figures of column (3). Column (5) indicates the extra welfare payment per the total number of 100 included in the experimental group. The figures in column (5) were arrived at by dividing the figures of column (4) by 100. The minus figures of $540 during years 1 and 2 could be treated either as societal costs or disbenefits. If this figure of (-)$540 is treated as societal costs, it should not be included in the benefit analysis. Similarly, if (-)$540 are treated as disbenefits, these should not be included as societal costs.

Since our societal costs did not include average transfer payment of $540 to the trainee, the will subsequently be included in the benefit analysis.

(3) Societal benefits due to reduction in crime. The annual societal costs for the crimes committed by the experimental and control groups could be found by multiplying the number of crimes of different types with the average loss to society in dollars per crime. This is shown below in Table 4-9.

TABLE 4-9

Annual Societal Losses Due to Crimes By Experimental and Control Groups

Type of Crime	Experimental Group			Control Group		
	No Crimes Per Year	Average Societal Loss Per Crime	Total Societal Loss	No Crimes Per Year	Average Societal Loss Per Crime	Total Societal Loss
(1)	(2)	(3)	(4)=(2)x(3)	(5)	(6)	(7)=(5)x(6)
A	15	$ 500	$ 7,500	20	$ 500	$10,000
B	10	2,000	20,000	15	2,000	30,000
C	5	2,500	12,500	10	2,500	25,000
D	-	5,000	-	5	5,000	25,000
TOTAL	30		$40,000	50		$90,000

The total annual losses to society due to crimes committed by the control group are $90,000; the losses by the experimental group amount to $40,000. Therefore, it may be concluded that society gains $50,000 per year due to vocational education programs, assuming that other social, economic, and cultural factors responsible for the perpetration of crimes operated alike for the experimental and control group. The annual benefits to society per student as a result of crime reduction will be $500 ($50,000 ÷ 100) during years 1 to 8.

We can now add the societal benefits to economy, reduction in welfare payments and crime rates. This has been done in Table 4-10.

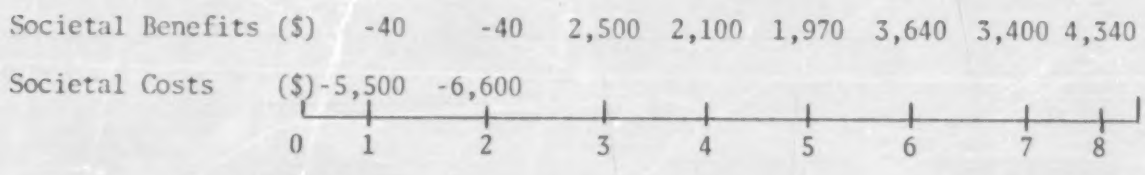
TABLE 4-10

Societal Benefits Due to Machine Shop Program Per Student

Year	Benefit to Economy Per Student	Benefit Due to Reduction in Welfare Payment	Benefit Due to Reduction in Crime	Total Societal Benefits
1	$ -*	$ 540	$ 500	(-)$ 40
2	-*	(-)540	500	(-)$ 40
3	2,000	-	500	2,500
4	1,600	-	500	2,100
5	1,200	270	500	1,970
6	2,600	540	500	3,640
7	2,360	540	500	3,400
8	3,300	540	500	4,340
TOTAL	$13,060	$ 810	$4,000	$17,870

The societal costs and benefits of the

be shown on the cash flow diagram as shown below.



The present values of the societal costs during years 1 and 2 were calculated earlier at a 5 percent interest rate and were found as $11,224 (after rounding to the closest dollar).

The present values of the societal benefits during years 1 to 8 could be found by discounting societal benefits during years 1 to 8 at 5 percent interest rate compounded yearly. This has been done in Table 4-11 below.

TABLE 4-11

Present Values of Societal Benefits of Machine Shop Program

Year (1)	Societal Benefits Per Student (2)	Present Worth Factor at 5% (3)	Present Value (4)
1	$ -40	.9524	$(-) 38.10
2	-40	.9070	(-) 36.28
3	2,500	.8638	2,159.50
4	2,100	.8227	1,727.67
5	1,970	.7835	1,543.50
6	3,640	.7462	2,716.17
7	3,400	.7107	2,416.38
8	4,340	.6768	2,937.21
TOTAL	$17,870		$13,426.05

The present values of the societal benefits of a machine shop program per student come out as $13,426 (after rounding). What does this mean? The concept of present value was explained earlier. The explanation is offered once again in order to reinforce the underlying idea behind present value concept. The total present value of societal benefits amounting to $13,426 are equivalent to the benefits of $(-)40 during years one and two, $2,500 during year 3, and so on. The two series of societal benefits (one being $13,426 and the other being $-40 during years one and two, $2,500 during year 3 and so on) are substitutable at 5 percent interest rate compounded yearly only. However, these two series are not equivalent at any other interest rate except 5 percent compounded annually.

Having calculated the present values of the societal costs and benefits, we are now ready to apply the present value method of analysis of data on costs and benefits. This is done by calculating the net present values of the societal benefits as shown below:

Present value of the societal benefits of machine shop program per student =	$13,426
Present value of the societal costs of machine shop program per student =	$11,224
Net present value of the societal benefits of machine shop program per student =	$ 2,202

The net present value of the societal benefits of the machine shop program per student comes out as $2,262. This indicates that at time period zero, or now, society stands to gain $2,202 per student after meeting the societal costs incurred during years 1 and 2. Since the net present value of societal benefits came out as a plus figure, it could be

concluded that economically, the machine shop program is a sound program.

It is possible to have negative net societal benefits of a vocational program. The significance of negative net societal benefits is that the present value of societal costs exceeds the present value of societal benefits. Such a program giving negative net societal benefits could not be justified on economic grounds. However, programs having negative present values of societal benefits could be justified on non-economic grounds, since economic criteria are not the only criteria in the justification of certain programs like homemaking.

Comments on Example 1

The societal costs for the machine shop program during year 1 were given in some detail. The main reason for this was to point out that a different basis could be used for allocating joint costs. It will be noted that administrative costs at the departmental, school, and district levels were allocated on the basis of the contact hours generated; the administrative costs at the district, state and federal levels were allocated on the basis of full time equivalent students. What are the best bases for allocating joint costs? This question was also raised earlier in Chapter 2. It was stated that there are no specific answers to this question. Costing of educational programs is an art rather than a science, especially when it comes to allocating joint indirect costs. However, it is important that all the districts in Wisconsin should have uniform procedures of costing. Such procedures should be mutually agreed upon by the parties involved.

The experimental and control groups were set up in the example prior

to the start of the training program. Most of the cost-benefit studies select a control group after the programs have terminated. The selection of the post-facto control group introduces bias in the study and should be avoided.

The matching of the members of experimental and control groups on a one-to-one basis often poses a serious problem. This has already been discussed at length in Chapters II and III. It was suggested that the matching of the two groups based on social, economic, and educational characteristics should be done as much as is allowed in a given situation.

One problem associated with the benefit analysis is to determine the time period over which the societal benefits from vocational programs should be included in the study. The data in the example were manipulated by giving a larger raise of 50 cents per hour to the control group and 30 cents per hour to the experimental group. This resulted in the equalization of their gross earnings at the end of 8 years. Thus, the study period was limited to 8 years, which included 2 years of training and 6 years of employment for the machine shop program students. Does this actually happen in life? The author believes that it may, but the actual period of equalization is normally longer than 8 years.

Some assumptions were made regarding the employment of the experimental and control groups. It was assumed that the unemployment of the experimental and control groups occurred during the last years of the total 8 years. The purpose of making such an assumption was that even in real life all the data required to conduct benefit analysis may not be available.

As such, the analyst will be called upon to make valid assumptions conforming to real life situations. The assumptions made by the analyst should be realistic and spelled out explicitly.

The present values of societal costs and benefits were computed at 5 percent interest rate compounded annually. In connection with this, it should be pointed out that realistic social interest rates must be used in discounting. If too low interest rates are used in discounting societal costs and benefits, it results in high net societal benefits due to vocational programs, because societal costs are usally incurred during the initial years and the societal benefits accrue for several years after the graduation of students. Since the present worth factor formula at the lower interest rate have higher values as compared to the present worth factor at higher interest rates, the societal costs incurred during one or two years are multiplied by higher numbers, the societal benefits also are multiplied by higher numbers but over several years. The net result is to increase the present value of the societal benefits proportionately more than the present value of the societal costs at lower interest rates. To give an example, the present value of the societal benefits at 4 percent compounded yearly came out as $14,192.87. The present value of the societal costs at the same 4 percent interest came to $11,390.61. Thus, at 4 percent interest rate compounded annually, the net societal benefits came out as $2,802.26 ($14,192.87) - ($11,390.61). It will be recalled that at 5 percent interest rate, the net societal benefits were found as $2,202 earlier. Thus, the lowering of interest rate by 1 percent (from 5 percent to 4 percent) increased the net societal benefits by approximately $600 per student. The reverse happens when high social interest rates are used.

The example ignored the multiplier effect of the employment. This was done to keep the example rather simple.

The present value of the net societal benefits of the vocational programs represent such benefits at time period zero. The information given by the present value of the net societal benefits could be misleading unless the years during which societal costs are incurred and the years during which societal benefits accrue are also spelled out. In order to remedy this situation, another method called annual value of net benefits is used. This method is discussed below.

B Annual Value of Net Benefits Methods.

Under this method, all the societal costs and benefits are distributed equally over the study period. The difference between the annual societal benefits and annual societal costs gives the annual net societal benefits of a vocational program. If the annual societal benefits are more than the annual societal costs, it indicates that society is getting more benefits annually as compared to the annual societal costs. The procedures involved in using this method are explained by the data of example 1 discussed earlier in connection with the present value method.

Solution to Example 1 (Annual Net Benefits Method).

It will be recalled that the societal costs and benefits of machine shop program were computed during years 1 to 8 and shown on the cash flow diagram as below:

Societal Benefits ($)	-40	-40	-2,500	2,100	1,970	3,640	3,400	4,340
Societal Costs ($)	-5,500	-6,600						
	0	1	2	3	4	5	6	7	8

The aim of the annual value net benefits is to distribute societal costs and benefits equally over 8 years. This is achieved by multiplying the present values of the societal costs and benefits by capital recovery factor at the appropriate interest rate. The use of the capital recovery factor in costing capital assets like buildings and equipment was also discussed earlier in Chapter II in connection with the costing of the space and equipment inputs.

The present values of the societal costs of $5,500 and $6,600 during years 1 and 2 at 5 percent interest rate compounded yearly was found earlier as $11,224.40. The annual societal costs of the machine shop program per student during years 1 to 8 will be calculated as shown below.

Annual Societal Costs Per Student = (Present Value of Societal Costs) x (Capital Recovery Factor at Appropriate Interest Rate and Time Period)

The annual societal costs per student amounting to $1736.64 were calculated by multiplying the present value of the societal costs at $11,224.40 by capital recovery factor at 5 percent and 8 years. The reason for using 5 percent interest rate was that the same rate was used for calculating the present value of the societal costs. The reason for using 8 years was that the societal costs were intended to be distributed equally during years 1 to 8.

The significance of the annual societal costs could be explained as follows. Supposing society were to borrow $11,224.40 at time period zero at 5 percent rate and with the intention of paying the money borrowed in equal year end payments from year 1 to year 8, the annual payment on such a loan will come to $1736.64. At the end of 8 years the whole loan ,

including the interest, will be paid back, if an annual payment of $1736.64 was made to the lender. Thus, it could be said that the machine shop program is costing the society annually $1736.64 from year 1 to year 8.

The present value of the societal benefits was also calculated earlier at 5 percent and was found as $13,426.05. The annual value of the societal benefits could be found by using the same procedures as were applied to societal costs. This is shown below:

Annual Value of Societal Benefits = (Present Value of Societal Benefits) x (Capital Recovery Factor at Appropriate Interest and Time Period) =

($13,426.05) x (.15472). = $2077.28

Having calculated annual societal benefits and societal costs, we can find the next annual societal benefits due to a machine shop program per student as shown below:

Annual value of societal benefits from machine shop program per student = $2077.28

Annual value of societal costs from machine shop program per student = $1736.64

Net annual value of societal benefits from machine shop program per student = $340.64

Thus, the society net gain as a result of the machine shop program per student is approximately $341 (after rounding) during years 1 to 8. The program can be justified economically, as the annual societal gains are more than the annual societal costs.

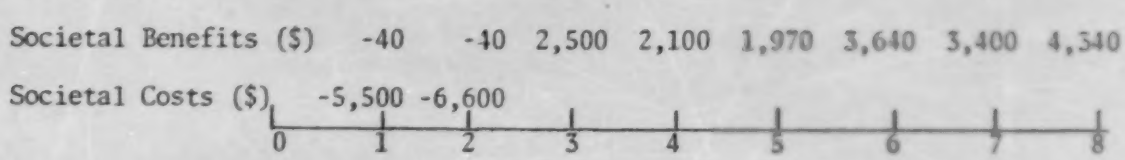
C Rate of Return Method

The third method of analyzing data related to societal costs and benefits is called rate of return method (sometimes also called as internal rate of return method). Rate of return is defined as that interest rate

at which the present value of the net societal benefits is zero. The application of this method is shown by the data of example 1.

Solution Example 1 (Rate of Return Method).

Let us once again draw the cash flow diagram of the societal costs and benefits during years 1 to 8 for the machine shop program. This is shown below.



We found earlier that at 5 percent interest rate, the present value of the societal costs was $11,224.40; and the present value of the societal benefits was $13,426.05. Thus, at 5 percent interest rate, the present value of net societal benefits of the machine shop program were $2,202.

We also said earlier that at 4 percent interest rate, the present value of the societal benefits and costs was $14,192.87 and $11,390.61, respectively, thus giving a net societal benefit of approximately $2,802.

We defined rate of interest as that rate at which the net societal benefits are equal to zero. Since at 5 percent interest rate the net societal benefits are $2,202 and at 4 percent the net societal benefits are $2,802, the rate of return which makes net societal benefits equal to zero must be higher than 5 percent. This is due to the fact that in our case, lowering of interest rate from 5 percent to 4 percent increased the net societal benefits, and we want to reduce it to zero. Having concluded that the rate of return is more than 5 percent, the task of finding the interest rate requires a trial and error method. This is discussed below.

Let us compute the present values of the societal costs and benefits at a 6 percent interest rate. This is shown in Table 4-12 below.

TABLE 4-12

Present Values of Societal Costs and Benefits
At 6 Percent Interest Rate Compounded Yearly

Year (1)	Present Worth Factor (2)	Societal Costs (3)	Present Value Societal Costs (4)=(2)x(3)	Societal Benefits (5)	Present Value Societal Benefits (6)=(2)x(5)
1	.9434	$5,500	$5,188.70	$ -40	$(-) 37.74
2	.8900	$6,600	$5,874.00	-40	(-) 35.60
3	.8396			2,500	2,099.00
4	.7921			2,100	1,663.41
5	.7473			1,970	1,472.18
6	.7050			3,640	2,566.20
7	.6651			3,400	2,261.34
8	.6274			4,340	2,722.92
TOTAL			$11,062.70		$12,711.71

Since by using 6 percent, the societal benefits exceed societal costs by $1649.01 ($12,711.71 - 11,062.70), this indicates the rate of return is still more than 6 percent. So let us try 8 percent. This is shown in Table 4-13 on the following page.

TABLE 4-13

Present Values of Societal Costs and Benefits At 8 Percent Interest Rate Compounded Yearly

Year (1)	Present Worth Factor (2)	Societal Costs (3)	Present Value Societal Costs (4)=(2)x(3)	Societal Benefits (5)	Present Value Societal Benefits (6)=(2)x(5)
1	.9259	$5,500	$5,092.45	$ - 40	$(-) 37.04
2	.8573	$6,600	$5,658.19	- 40	(-) 34.29
3	.7938			2,500	1,984.50
4	.7350			$ 2,100	$ 1,543.50
5	.6806			1,970	1,340.78
6	.6302			3,640	2,293.93
7	.5835			3,400	1,983.90
8	.5403			4,340	2,344.90
TOTAL			$10,750.63		$ 11,420.18

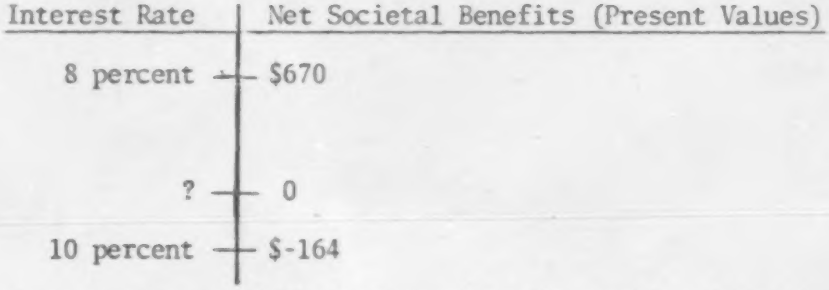
By using 8 percent interest rate, we get a net societal benefit of $669.55 (11,420.18 - 10,750.63). This indicates the interest rate is still higher than 8 percent. It should be noted that the net societal benefits are decreasing as the interest rate increases. Since we do not have the value of present worth factor at 9 percent, let us try 10 percent. This is done in Table 4-14 on the following page.

TABLE 4-14

Present Values of Societal Costs and Benefits At 10 Percent Interest Rate Compounded Yearly

Year	Present Worth Factor	Societal Costs	Present Values of Societal Costs	Societal Benefits	Present Values of Societal Benefits
(1)	(2)	(3)	(4)=(2)x(3)	(5)	(6)=(2)x(5)
1	.9091	$5,500	$5000.05	$- 40	$ - 33.36
2	.8264	$6,600	5454.24	- 40	33.06
3	.7513			2,500	1,878.25
4	.6830			$2,100	$1,434.30
5	.6209			1,970	1,233.18
6	.5645			3,640	2,054.78
7	.5132			3,400	1,744.88
8	.4665			4,340	2,024.61
TOTAL			$10,454.29		$10,290.58

It will be seen from Table 4-14 that by using the 10 percent interest rate, the present value of the societal benefit is less than the present value of the societal costs. In other words, the net societal benefits at 10 percent were $(-)163.71. The net societal benefits at 8 percent as computed in Table 4-13 earlier were $669.55. Summarizing, the 8 percent interest rate gives a positive dollar figure of net societal benefits and 10 percent gives a negative dollar figure. Since we want the interest rate at which the present value of net societal benefits is zero, we can find the required interest rate or rate of return by interpolation. The process of interpolation is shown and explained below by drawing a vertical line.



The vertical line has two scales. On the left hand scale, we have denoted the interest rates. So, let us call the left hand side of the line interest scale line. The right hand side represents the present values of net societal benefits corresponding to interest rates on the opposite scale. Let us call the right hand side net benefit scale.

At 8 percent interest rate, the net societal benefits are $670; and at the 10 percent interest rate, the net societal benefits are $-164. Somewhere between $670 and $(-)164, we have zero net societal benefits. Our problem is to find the interest rate which corresponds to zero net societal benefits. This can be computed as shown on the following page.

If the difference on the benefit scale is $834 ($670 - 164), the difference on the interest scale is equal to 2 percent (10-8).

If the difference on the benefit scale is $1, the difference on the interest scale is equal to 2 percent divided by $834. (or .02 ÷ 834), which comes out as .00002398.

If the difference on the benefit scale is $ 0, the difference on the interest scale is .00002398 x ($670), which comes out to .01606714 or approximately 1.6 percent after rounding. This means that on the interest scale the distance between 8 percent (corresponding to societal present value of net benefits of $670) and the required interest rate (corresponding to societal present value of net benefits of $0) is 1.6 percent. So the required interest rate is 9.6 percent (8 + 1.6).

The interpolation of the rate of return could also have been done by working on the other side of the scale at 10 percent and the corresponding net present value of societal benefits as $-164. This is shown below.

We already figured out that if the difference on the benefit scale is $1, the difference on the interest scale is .00002398. If the difference on the benefit scale is $164, the difference on the interest scale is (.00002398) x (164) = .00393272 or approximately .004 (or four-tenths of a percent). Thus, the required rate of return is once again 9.6 percent (10-.4). It should be noted that when we operated on the lower end of the scale, we substracted the distance on the interest line from the lowest extreme interest value. When we operated from the upper end of the interest scale, we added the distance to the uppermost interest value on the scale.

Interpretation of the Rate or Return

The 9.6 percent rate of return indicates that society, by investing per student $5,500 during year 1 and $6,600 during year 2 in the machine shop program is getting a rate of return of 9.6 percent. How could one use the computed rate of return to justify an educational program? The computed rate of return is compared with the societal time value of money. If the computed rates is equal to or larger than the societal time value of money, the program is said to have passed the test of rate of return criterion. Since in our example, the societal time value of money was 5 percent and the machine shop program is giving a return of 9.6 percent (which is significantly larger than the societal time value) it could be said that the machine shop program could be justified economically. If the societal time value of money was 10 perccent instead of 5 percent, the machine shop program could not be justified economically.

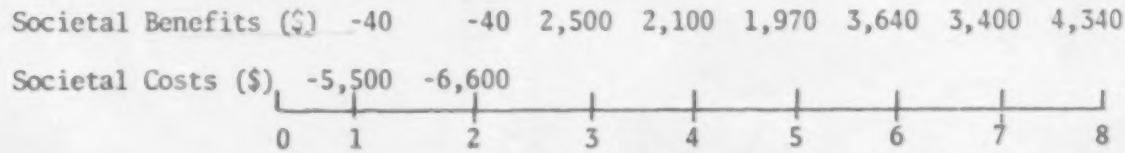
Difference Between Gross Rate of Return and Incremental Rate of Return

The gross rate of return represents the rate of return on the total investment on an educational program. The 9.6 percent rate of return computed earlier on the data of example 1 was the gross rate of return, as it represented the return on the total societal costs incurred by society on the machine shop program.

The incremental rate of return is the return on the incremental investment. The procedures and applications of the incremental rate of return are illustrated by the following example.

Example 2 (Incremental Rate of Return)

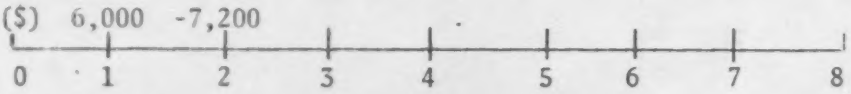
The machine shop program discussed earlier and designated as Program A had the following cash flow diagram.



Let us assume that the machine shop program could be improved by having better instructors, equipment, and curriculum. As a result of improvements in the program, the societal costs and benefits during years 1 to 8 are assumed to increase. The cash flow diagram of the improved program designated as Program B is given below.

Societal Benefit ($) -40 -40 3,000 2,500 2,200 4,600 3,900 4,500

Societal Costs ($) 6,000 -7,200



Find the gross return on Program B. Also, find the incremental rate of return on Program B as compared to Program A. Which program should be implemented if the societal time value of money is 5 percent?

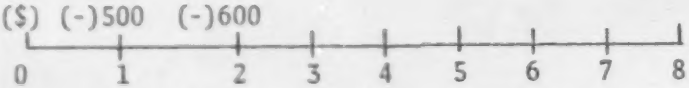
Solution to Example 2

The gross rate of return on Program B was calculated using the same procedures as Program A. The gross rate of return by hit and trial was found as 10.5 percent.

The incremental rate of return could be found by drawing another cash flow diagram which shows the incremental societal costs and benefits during years 1 to 8. This is shown below:

Incremental
Societal Benefits ($) 500 600 230 360 500 160

Incremental
Societal Costs ($) (-)500 (-)600



It may be appropriate to explain briefly the incremental cash flow diagram. During year 1, the societal costs on Program A were $5,500 and for Program B were $6,000. Thus, the societal incremental costs for Program B were $500 more than Program A during year 1. Similarly, the incremental societal costs for Program B as compared to Program A are $600 ($7,200 - 6,600).

The societal benefits for both programs during years 1 and 2 were $(-)40 for each year. Thus, there were no incremental societal benefits from Program B as compared to Program A during years 1 and 2. During year 3, the societal benefits from Program B and A were $3,000 and $2,500 respectively. Thus, there was an incremental societal benefit of $500 from Program B as compared to Program A. The incremental societal benefits from Program B as compared to Program A during years 4 to 8 were calculated

Having drawn incremental cash flow diagrams, we can calculate the incremental rate of return by the hit and trial method. This was done, and the incremental rate of return was found as 21.94 percent. This implies that the incremental or extra societal costs of $500 during year 1 and $600 during year 2 for Program B as compared to Program A, gives back to society a return of 21.94 percent--which is more than the societal time value of money at 5 percent. This implies that society would be better off by implementing Program B rather than Program A as the extra or incremental costs give a return of 21.94 percent, which is much higher than the societal time value of money at 5 percent.

We could have concluded Program B is better than Program A by comparing the gross return on each of these programs. Program B had a gross return of 10.5 percent and Program A as 9.6 percent. However, this method of deciding by comparing gross returns on two alternative programs is not correct. The correct procedure to use in deciding between two or more alternative programs is to use incremental rate of return analysis. The procedural steps involved in using incremental rate of return analysis are listed on the following page:

(1) Rank various alternative programs according to the magnitude of the societal costs. The alternative which is least expensive is ranked as 1, the next expensive alternative is ranked as 2, and so on.

(2) Find the gross rate of return on the least expensive alternative which is ranked as 1. Compare it with the societal time value of money. If the gross rate of return on ranked alternative 1 is equal to or more than societal time value of money, this alternative is regarded as feasible. If the gross rate of return is less than societal time value of money, the alternative is not acceptable; in which case find the gross return on the next ranked alternative, until we hit an alternative program which is acceptable or which gives a rate or return equal to or more than the societal time value of money.

(3) Once an alternative is found which is acceptable (called a base plan), start using incremental return analysis on the next ranked expensive alternative. If the incremental rate of return on the next expensive alternative is equal to or more than societal time value of money, the next expensive alternative becomes the base plan and is compared with the next expensive alternative by using incremental rate of return analysis.

If in the process of finding incremental rate of return on the next expensive alternative, it is found that the incremental rate of return is less than the societal time value of money, the expensive alternative is discarded and the base plan compared with the alternative ranked next to the discarded plan.

Thus, basically under the incremental rate of return method two alternative plans are compared at a time and a decision is

made as to which alternative is better. The preferred alternative is then compared with the next ranked alternative. By comparing two alternatives at a time, we are able to decide which is the best plan.

Comments on Rate of Return Method

It should be realized that the rate of return method is more time consuming as compared to present value or annual value of net benefits methods. The main reason for this is the hit and trial procedure used in calculating the gross or incremental rate of return.

One of the advantages of using rate of return methods in analyzing societal costs and benefits of vocational education programs is that they vividly bring out the concept of human capital. According to this concept the societal costs or investment in vocational education programs are like investment in human beings which give a return to the society. The public and the legislature can be kept informed about the rate of returns on various vocational programs. This will help them realize the potential benefits that accure from the investment in vocational education programs.

D. Benefit-Cost Ratio Method

The fourth method of analyzing data related to societal benefits and costs is called benefit-cost ratio method. Under this method a ratio is obtained by dividing present or annual value of societal benefits by the present or annual value of costs. If the ratio obtained is one or greater than one, it signifies that the vocational program is a good program. If the benefit-cost ratio for a program comes out as less than one, it signifies that economically the program cannot be justified. The application of this method is shown by the data of example 1.

Solution Example 1 (Benefit Cost Ratio Method)

It will be recalled that the present values of the societal costs of the machine shop program at 5 percent interest rate was found as $11,224.40 and the present value of the societal benefits was calculated as $13,426.05. The benefit-cost ratio of the machine shop program has been calculated below.

$$\text{Benefit-Cost Ratio of Machine Shop Program} = \frac{\text{Present Values of Societal Benefits}}{\text{Present Value of Societal Costs}} =$$

$$\frac{\$13,426}{\$11,224} = 1.20$$

Benefit-cost ratio can also be calculated by dividing the annual societal benefits from the machine shop program by the annual societal costs of the program. This has been done below.

$$\text{Benefit-Cost Ratio of Machine Shop Program} = \frac{\text{Annual Societal Benefits}}{\text{Annual Societal Costs}} =$$

$$\frac{\$2,077}{1,737} = 1.20$$

The benefit-cost ratio by using the present or annual societal benefits and costs comes out the same as 1.2. What does benefit-cost ratio of 1.2 mean? It means that for every dollar society invests in the machine shop program, it gets back $1.20. Thus, the society gains by investing in the machine shop program.

Gross and Incremental Benefit-Cost Ratio

The gross benefit-cost ratio represents the return to the society from the total investment in an educational program. The benefit-cost ratio of 1.2 (calculated above) from the machine shop program is the gross benefit-cost ratio.

The incremental benefit-cost ratio reflects the return to the society from the incremental or extra investment. The procedure for finding incremental benefit-cost ratio could be illustrated from the data of example 2 discussed earlier.

It will be recalled that the cash flow diagram on Program B as compared to Program A was as shown below:

Incremental Societal Benefits ($)			500	400	230	360	500	160
Incremental Societal Costs ($)	-500	-600						
	0	1	2	3	4	5	6	7	8

The present values of the incremental societal costs and benefits on Program B as compared to Program A have been calculated in Table 4-15 below.

TABEL 4-15

Present Values of Incremental Societal Costs and Benefits of Program B As Compared to Program A

Year (1)	Present Worth Factor at 5% (2)	Incremental Societal Costs (3)	Present Value Incremental Societal Costs (4)=(2)x(3)	Incremental Societal Benefits (5)	Present Value Incremental Societal Benefits (6)=(2)x(5)
1	.9524	$ 500	$ 476.20	$	$
2	.9070	600	544.20		
3	.8638			500	431.90
4	.8227			400	329.08
5	.7835			230	180.21
6	.7462			360	268.63
7	.7107			500	355.35
8	.6768			160	108.29
TOTAL		$1100	$1020.40	$2150	$1673.46

Table 4-15 reveals that the present value of incremental societal benefits on Program B as compared to Program A come out as $1673 (after rounding) at 5 percent interest rate compounded yearly. The present value of incremental societal costs at the same interest rate of 5 percent has been calculated as $1020 (after rounding). The incremental benefit cost-ratio on Program B as compared to Program A would be calculated as shown below.

$$\text{Incremental Benefit-Cost Ratio of Program B as Compared to Program A} = \frac{\text{Present Value Incremental Societal Benefits}}{\text{Present Value Incremental Societal Costs}} = \frac{\$1673}{1020} = 1.64$$

The incremental benefit-cost ratio on Program B as compared to Program A has been found as 1.64. What does it mean? It implies that for every extra dollar society invests on Program B as compared to Program A, it gets back $1.64. In other words, the extra investment is worth it. This makes Program B better than Program A.

Comments on Gross and Incremental Benefit-Cost Ratio

The concept of gross and incremental benefit-cost ratios are analogous to the concepts of gross and incremental rate of return. The remarks made earlier in connection with rate of return method also apply to benefit-cost ratio method. The most significant thing to remember is that whenever two or more alternatives for an educational program are being compared, one should utilize the incremental benefit-cost analysis rather than the gross benefit-cost analysis. The procedures outlined in connection with the incremental rate of return also apply to incremental benefit-cost ratio analysis.

Limitations of Benefit-Cost Ratio Method

One of the problems associated with the benefit-cost ratio method is the classification of items as societal costs or societal benefits. The classification of an item as societal costs or benefits affects the benefit-cost ratio. This is illustrated by the following example.

Let us take a vocational program in which the undisputed present values of the societal benefits and costs of this program are $20,000 and $10,000 respectively. There are some items amounting to $1000 (like welfare payments) which can either be classified as societal costs or societal disbenefits. If we treat $1000 as disbenefits, the societal benefit-cost ratio will be 1.9 as shown below.

$$\text{Societal Benefits-Cost Ratio} = \frac{\$20,000-1000}{\$10,000} = 1.9$$

If $1000 are treated as societal costs, the benefit-cost ratio of this program comes out as 2.22 as shown below.

$$\text{Societal Benefit-Cost Ratio} = \frac{\$20,000}{\$10,000-1000} = 2.22$$

Generally high benefit-cost ratio of a program is considered as good by the public or legislature. If the analyst is bent upon selling the program to the public or legislature, he can show the disputed item of $1000 as societal cost and get a high ratio of 2.22. On the other hand, if the analyst wants to downgrade the program, he can classify $1000 as societal disbenefits and get a low ratio of 1.9. Thus, the readers of the benefit-cost analysis reports should carefully look into the proper classification of items as societal costs and disbenefits, as this affects the benefit-cost ratio.

It may be mentioned in this connection that the classification of

items as societal costs or disbenefits does not pose any problem with the other methods of analysis, namely, present value, annual value of net benefits, and rate of return.

E. Payback Period Method

The last method of analysis of data related to societal costs and benefits is called payback period method. Under this method, the analyst calculates the period or years over which society recovers its investments in a vocational program. The application of this method is illustrated by the data in example 1.

Solution to Example 1

Payback period is defined as the period over which the present values of the societal costs at societal time value of money equal the present value of the societal benefits at the same interest rate.

Payback period for the machine shop program (Example 1) could be calculated from Table 4-16 shown below.

TABLE 4-16

Payback Period for Machine Shop Program
At 5 Percent Societal Time Value of Money

Year	Present Worth Factor at 5%	Societal Costs	Present Value Societal Costs	Cummulative Present Value Societal Costs	Societal Benefits	Present Value Societal Benefits	Cummulative Present Value Societal Benefits
(1)	(2)	(3)	(4)=(2)x(3)	(5)	(6)	(7)	(8)
1	.9524	$5,500	$ 5,238.20	$ 5,238.20	$(-) 40	$ - 38.10	$(-)38.10
2	.9070	6,600	5,986.20	11,224.40	(-) 40	(-)36.28	(-)74.38
3	.8638				2,500	2,159.50	2,085.12
4	.8227				2,100	1,727.67	3,812.79
5	.7835				1,970	1,543.50	5,356.29
6	.7462				3,640	2,716.17	8,072.46
7	.7107				3,400	2,416.38	10,488.84
8	.6768				4,340	2,937.21	13,426.05

The data in Table 4-16 reveal that the societal costs of $5,500 and $6,600 were incurred during years 1 and 2 respectively. The present value of the societal costs at 5 percent interest rate compounded annually is $11,224.40. Having worked out the present value of the societal costs, we start cummulating the present values of the societal benefits accrued during various years. This has been done in column (8) of Table 4-16. The data in column (8) reveal that the cumulative present value of societal benefits up to year 8 is $10,488.84 and for year 8 it is $13,426.05. Since we defined payback period as the period over which the present value of the societal costs are equal to the present value of societal benefits, it could be concluded that the payback period is between 7 and 8 years (for 7 years the cummulative present value of societal costs of $10,488.84 is less than the present value of cummulative societal costs of $11,224.40; and for 8 years the cummulative present value of societal benefits of $13,426.05 is more than the cummulative present value of societal costs of $11,224.40). The payback period could be found by interpolation between 7 and 8 years and was calculated as 7.25 years. The process of interpolation was explained earlier in connection with the rate of return method.

What does payback period of 7.25 years mean? It implies that the society gets back the money invested in the machine shop program in 7.25 years, if its time value of money is 5 percent. It may be mentioned that the payback period will be different, if some other interest rate was used.

Comments On Payback Period Method

One of the advantages of the pay-back period method is that it helps in determining the study period over which the benefits should be analyzed. Once we reach the period, over which the present value of the actual or estimated societal costs are equal to the present value of the actual or estimated societal benefits, we don't need any further information on the benefits which generally accrue to the society for a long time to come.

F. Comparing Different Methods of Analyzing Societal Benefits and Costs Data

The benefit-cost ratio method is most often used in analyzing social programs. The use of this method indirectly involves the use of either the present value or the annual value of benefits and costs. The interest rate used in finding the present or annual values of the societal costs and benefits affects the benefit-cost ratio. The social rate of interest should be carefully chosen. The author believes that since social programs are often non-profit programs, the interest rate used from time to time to finance such public programs should be used to determine the social interest rate.

One of the advantages of the benefit-cost ratios method as compared to other methods is that the benefit-cost ratios are easily understood by the general public and members of legislatures. The major disadvantage of the benefit-cost ratio method is, as compared to other methods, the benefit-cost ratio of a program can be manipulated by the classification of items as social costs or social disbenefits. This was discussed and

illustrated by an example earlier in this chapter. Another disadvantage of the benefit-cost ratio method is that generally members of the public and legislatures have a tendency to compare benefit-cost ratios of dissimiliar programs. For example, a ratio of 1350 to 1 has been estimated for the use of seat-belts, a ratio of 9 to 1 for the care of uterine cervix cancer, and a ratio of 1.5 to 1 to 3 to 1 for vocational programs.[1] It will be irrelevant to compare the ratios of these dissimiliar programs. The high ratio associated with the use of safety belt programs does not imply that all public funds be diverted towards this program because it has a very high benefit-cost ratio. The proper use of the benefit-cost ratio method is to compare alternatives for the same program. For example, vocational education programs may have several alternatives, such as full time day programs, part time day programs, apprenticeships and so on. The benefit-cost ratios of various alternatives may help the decision makers in selecting the best alternative or mix of alternatives to optimize the return to society from the investment made in the selected alternative(s). Similarly, comparison of benefit-cost ratios of various vocational programs like machine shop, nursing, data processing, retailing, etc. should be done carefully.

Between the present value and annual net value methods, the author believes that the annual value of the net benefits is more efficient in indicating the results of the societal costs and benefits associated with an educational program. The reason for this statement is that the general

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[1] See Arnold Kotz (ed) "Occupational Education: Planning and Programming", Vol II, Stanford Research Institute, Menlo Park, California. September, 1967, page 306.

public and members of the legislature comprehend better the annual net value of societal benefits from the program rather than the present value of the net societal benefits. Moreover, the information regarding the annual net societal benefits conforms to the budgets which are usually based on annual data on costs and income.

The rate of return method has the advantage of emphasizing the concept of investment in vocational education as the investment in human capital. The disadvantage of this method is that the concept of the rate of return is often not comprehended by the general public. Moreover, the calculation of the rate of return on an educational program takes more time as compared to other methods. However, the time-consuming process in calculating the rate of return by hit and trial method should not be an argument against the use of this method; it takes a lot of time and effort to collect the raw data related to societal costs and benefits. If one can afford to spend months in collecting raw data, one can also afford a few hours extra to calculate the rate of return, if this information serves some useful purpose. The author believes that the rate of return gives members of the legislature a useful piece of information in deciding about the allocation of funds to such a program, and as such, should be provided whenever it is available.

One of the disadvantages of all the methods except the pay-back period method is that they require the estimation of a time-period over which the societal benefits accrue to society. The pay-back period method has the advantage in this regard, as it determines the study period over which the actual or estimated societal costs are equal to the actual or estimated

societal benefits. The disadvantage of the pay-back period method is that like net present value and net annual societal benefit methods, the pay-back depends upon the interest rate used in discounting societal costs and benefits. Another disadvantage associated with the pay-back period is that it does not depict completely all the societal benefits accrued after this pay-back period. In spite of this limitation, the pay-back period is a very useful and comprehendable information for general public and members of legislature.

The disadvantage associated with all five methods is that they completely ignore non-monetary societal costs and benefits. The author believes that the non-monetary aspect of societal costs and benefits should be reported to general public and members of legislatures, so that they have a complete picture of the impacts of vocational programs.

In summary, it may be stated that all the methods have advantages and disadvantages. Which method(s) should be employed in analyzing societal costs and benefits? The author suggests that the selection of appropriate method(s) should be determined by the nature of the for whom the studies are done.

Summary

In summary, this chapter discussed five different methods of analyzing data related to societal costs and benefits of vocational and manpower programs. The methods discussed included present value of net benefits method, annual value of net benefits method, rate of return method, benefit-cost ratio method, and pay-back period method. The procedural steps involved in using the above mentioned methods were illustrated by hypothetical examples. The advantages and disadvantages of each method were mentioned briefly. Finally, a comparison among various methods was done.

Chapter V

INFORMATION SYSTEM FOR SOCIETAL COST AND BENEFIT ANALYSIS OF VOCATIONAL AND MANPOWER PROGRAMS

INTRODUCTION

One of the major problems in the area of establishing societal costs and benefits of vocational and manpower programs is the lack of relevant data. This problem was highlighted earlier in Chapter II in connection with the problems and issues related to establishing societal costs. The magnitude of this problem is more in the area of societal benefits, as the follow-up studies of vocational graduates do not heavily incorporate the societal benefit aspects of vocational programs.

There is a great need to develop a management information system for vocational, technical and adult education in the State of Wisconsin. This need has been often expressed by the district directors in their meetings over the last few years. The management information system to be developed for the Vocational Education system should be user oriented. In other words, such an information system should meet the needs of the decision and policy makers, planners, and researchers in the vocational Education system. The information required for establishing and analyzing private, governmental and societal costs and benefits of vocational programs should be incorporated in such a management information system. This chapter provides the information requirements for establishing societal costs and benefits of vocational manpower program.

INFORMATION REQUIREMENTS FOR ESTABLISHING SOCIETAL UNIT COSTS OF A VOCATIONAL PROGRAM

The information requirements for establishing societal unit cost of

a vocational program are based upon the procedures suggested in Chapter II. The required information for implementing various steps in establishing societal costs is given below.

A. Information Required For Curriculum Matrix

1. Courses included in a vocational program and whether these are required or elective courses for that program. If a course is elective, the percentage of students who take elective courses.
2. Contact hours of identified courses included in the program.
3. What other vocational programs make use of identified courses? Are these courses required or elective for the other identified programs?
4. The percentage of students of other identified programs who take elective courses.

B. Information Required For Establishing Faculty Cost of a Course

1. The faculty member(s) who taught the course.
2. The gross salary and fringe benefits paid by the state to faculty member(s) who taught the course.
3. Traveling expenses paid.
4. Full time teaching load of the faculty member(s) in terms of credit or contact hours who taught the course.
5. Credit or contact hours of the course.
6. Enrollment in the course.

C. Information Required For Establishing Space Cost of a Course

1. Building in which the course was taught.
2. Area of the building excluding hallways and restrooms.
3. Areas used by administration, auxillary services and instruction.

4. Areas of the different rooms used for instruction.
5. Utilization of different rooms used for instruction in terms of hours per week.
6. The cost of building in the year in which it was built.
7. The cost of land in the year it was acquired.
8. The remaining estimated life of the building.
9. Bond rate(s) in the year(s) in which land and buildings were acquired.
10. Permanent improvement costs on the land and buildings and the years in which these were made.
11. The societal time value of money for the years in which improvements on the land and buildings were made.
12. The maintenance expenses of the land and buildings during the years for which societal costs of the vocational program are being established.
13. The expenses for utilities (heat, light, water) during the years for which societal costs of the vocational program are being established.
14. Enrollment in the course.

D. Information Required For Establishing Equipment Cost of a Course.

1. An inventory of the equipment utilized for teaching the course.
2. Other courses that utilized the equipment.
3. The cost of identified equipment during the year(s) of purchase.
4. The remaining estimated instructional life of the equipment.

5. An estimated resale value of the equipment at the end of the life of the equipment.
6. Maintenance and repair costs of the equipment during the years for which societal costs are being established.
7. Societal time value of money in the years in which the equipment was purchased.
8. Enrollment in the course.

E. Information Required For Establishing Supply Costs of a Course

1. Direct supply costs used in the course.
2. Indirect supply costs including costs of ordering, storing, and issuing of supplies.
3. Appropriate base to allocate indirect supply costs to the course.
4. The enrollment in the course.

F. Information Required For Establishing Departmental Administrative Costs of a Course

1. Identification of the departmental staff (Department head and clerical) associated with the course.
2. The gross salaries including fringe benefits paid during the years for which societal costs of a vocational program are being established.
3. The travelling expenses paid by the state.
4. Release time for administrative responsibilities in terms of credit or contact hours per week.
5. Instructional responsibilities in terms of credit or contact hours per week.

6. The space cost associated with departmental supervision.
7. The equipment costs associated with departmental supervision.
8. The supply costs associated with departmental supervision.
9. Appropriate base to allocate departmental supervision to courses included in the department.
10. The enrollment in the course.

G. Information Required For Establishing Administrative Costs of a Course At School or District Level.

1. Administrative divisions in the school or district and their major functions.
2. The gross salary and fringe benefits paid by the state to the staff in various divisions.
3. The travelling expenses paid to the staff of various divisions.
4. Space costs associated with a division.
5. Equipment cost associated with a division.
6. Supply cost associated with a division.
7. Appropriate base to allocate administrative divisional costs to auxiliary services and instruction.
8. Appropriate base to allocate indirect auxiliary service costs to instruction.
9. Appropriate base to allocate indirect instructional costs to courses.

H. Information Required for Establishing Auxiliary Service Costs of a Course.

1. The gross salary and fringe benefits paid to the staff of an auxiliary service.

2. The travelling expense paid to the staff of the auxiliary service.
3. Space cost associated with the auxiliary service.
4. Equipment cost associated with the auxiliary service.
5. Supply cost associated with the auxiliary service.
6. Income (if any) generated by the auxiliary service.
7. Indirect administrative costs allocated to the auxiliary service (Discussed in section G).
8. Appropriate base to allocate auxiliary service costs to the course.
9. Enrollment in the course.

I. Information Regarding Some Appropriate Bases for Allocating Joint Costs to a Course.

1. Total credit or contact hours generated in the day and evening programs.
2. Total credit or contact hours generated in the course.
3. The number of full-time students in various programs.
4. The number of part-time students in various programs.
5. Appropriate base to convert part-time students into full-time students.
6. The number of faculty and staff members in various instructional departments.
7. The number of staff personnel in various administrative divisions and auxiliary services.

J. Information Regarding Societal Opportunity Cost of Students Enrolled In Vocational Programs Rather Than Being Employed During Their Training Program

1. The gross earnings including fringe benefits paid by society to the members of the experimental and control groups during the training program period.
2. The matching of the experimental and control groups on the bases of the characteristics which follow.
3. Age.
4. Race.
5. Sex.
6. Location (urban, rural, metropolitan).
7. Parents' income.
8. Parents' education.
9. Parents' profession.
10. Parents' family size.
11. Curriculum (vocational, college-bound, etc.).
12. I.Q.
13. Grade Point Average.
14. Years of schooling.
15. Work experience.

K. Information Regarding Societal Opportunity Costs Due to the Nature of Educational System Leading to Loss of Such Taxes as Sales Tax, Property Tax, etc.

1. Sales tax rate during the years of training program.
2. Dollar cost of purchases of goods and services for a vocational program.

3. Property tax rate during the years of training program.
4. Assessed value of the buildings, lands, and equipment.
5. Appropriate basis for allocating sales and property taxes to the vocational program.

L. Information Requirements for Establishing Societal Unit Benefits of a Vocational Program.

The information required for establishing societal unit benefits of a vocational program is based upon the suggested procedures discussed in Chapter III. The required information in establishing societal unit benefits is given below.

M. Information Required For Establishing Benefits to Economy.

1. Actual and estimated gross earnings including fringe benefits paid to the graduates of a vocational program (experimental group) and control groups during the years of the selected period for the study.
2. The employment years of the members of the experimental and control groups.
3. Societal time value of money.
4. The matching of the characteristics of the experimental and control groups included in section J.

N. Information Required for Establishing Indirect Employment Benefits of a Vocational Program.

1. The rate of multiplier effect.
2. The years of employment of the members of experimental and control groups.

3. The estimated gross wages or income earned including fringe benefits by workers indirectly employed as a result of the employment of the experimental and control groups during the years of the selected period of study.
4. Societal time value of money.
5. Number of students in the experimental group.

O. Information Required for Establishing Societal Benefits Due to Reduction in Crime Rate.

1. Information regarding characteristics of the experimental and control groups listed in section J.
2. Estimated number and types of crimes committed by the members of the experimental and control groups during the years of selected period of study.
3. Estimated societal costs of different types of crimes.
4. Number of students in the experimental group.
5. Societal time value of money.

P. Information Required for Establishing Benefits Due to Reduction In Welfare Payments.

1. Information on the characteristics of the members of experimental and control groups as listed in Section J.
2. Number of welfare recipients in the experimental and control groups.
3. Estimated welfare payments including food stamps to be made to the members of experimental and control groups during the years of the selected period of study.

4. The societal time value of money

5. Number of students in the experimental group

Summary

This chapter listed the information required for establishing societal unit costs and benefits of a vocational program. It is felt that a list of various types of information required for establishing unit societal costs and benefits of a vocational program will help in identifying the data elements which will provide the required information. The management information system to be developed for the vocational, technical and adult education system in the state of Wisconsin should consider the information requirements for analyzing societal costs and benefits of various vocational programs.

Chapter VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATION

The manual developed in this study is primarily concerned with the identification and measurement of societal costs and benefits of vocational and manpower programs. Chapter II of this report focussed on the identification and measurement of societal costs of of vocational and manpower programs. The procedures for establishing costs of inputs used in instructional, administrative and auxiliary services are illustrated with examples. Chapter III relates to the identification and measurement of societal benefits as a result of offering vocational and manpower programs. The procedures used in measuring societal benefits are also illustrated with examples. Chapter IV deals with the analysis of data regarding costs and benefits of vocational and manpower programs. Five different -ethods (net present value of societal benefits, net annual value of societal benefits, rate of return, method benefit-cost ratio method and pay-back period method) are discussed and illustrated with examples. Finally, the information required for conducting cost-benefit studies of vocational and manpower programs has been listed in Chapter V.

One of the objectives of this study was to conduct a pilot study to test the suggested procedures for establishing societal costs and benefits of vocational and manpower programs. This was not done as the data required for implementing the suggested procedures were not readily available and the time allotted for the entire study was only six weeks.

RECOMMENDATIONS

(1) This manual related to the establishing of societal costs and benefits of vocational and manpower programs. It is recommended that similar manuals for establishing private and governmental costs and benefits of vocational and manpower programs be developed since these would serve a useful purpose. The information regarding private costs and benefits of vocational and manpower programs would be particularly useful to the guidance and counseling personnel in the State. The information regarding governmental costs and benefits of vocational and manpower programs would be very useful to the members of the state and federal legislatures. In this connection, it may be mentioned that the development of manuals for establishing private and governmental costs and benefits would not require much work, as this manual has laid the groundwork for the proposed manuals.

(2) Since all the vocational and manpower programs cannot be justified on the criteria of costs and benefits of such programs, it is recommended that a manual for establishing costs and effectiveness of vocational and manpower programs be developed. This manual will require a great deal of work, especially in establishing and measuring the effectiveness criteria of various vocational and manpower programs The effectiveness criteria will require an update from time to time as these may change from year to year. The manual for establishing costs and effectiveness of vocational and manpower programs would be very useful in evaluating vocational education programs in the State.

(3) The SBVTAE and DPI should take steps to make all the post-secondary vocational institutes and secondary schools interested in cost-benefit and cost effectiveness studies of vocational programs. Short seminars (one to two weeks) could be held to train the researchers in conducting cost-benefit studies. After the researchers have been trained in the methodology of cost-benefit and cost effectiveness studies, a state-wide conference could be held to decide the basis for allocating joint costs and resolve other issues connected with such studies.

(4) The information required for measuring costs, benefits, and effectiveness of vocational programs should be a part of a total management information system for vocational education, at the secondary and post-secondary levels. The management information system to be developed should be user oriented or serve the needs of all the parties involved in the system. The management information system should be updated from time to time since the needs of all parties will change over time.

(5) The accounting system for identifying costs of vocational programs be overhauled. The improved cost-accounting system should identify cost data requirements for cost-benefit studies, decision-making, policy formulation, budgeting and reporting.

(6) The follow-up studies should incorporate information required for identifying benefits of vocational programs.

(7) A continuous program for conducting cost-benefit studies should be implemented in the state. However every year only a certain percentage of programs (e.g. 20 percent) would be selected randomly from a stratified population of programs without replacement.

This would imply that every program will be selected every five years for cost-benefit sutdies. The selected programs for cost-benefit studies during a year should be the same or very similar programs for various districts so that a comparison of costs and benefits among various districts could be made.

APPENDIX A

INTEREST TABLES

Table A-1. Single-payment Compound Amount Factor

Number of years (n)	Annual interest rate						
	3%	4%	5%	6%	7%	8%	10%
1	1.030	1.040	1.050	1.060	1.070	1.080	1.100
2	1.061	1.082	1.103	1.124	1.145	1.166	1.210
3	1.093	1.125	1.158	1.191	1.225	1.260	1.331
4	1.126	1.170	1.216	1.262	1.311	1.360	1.464
5	1.159	1.217	1.276	1.338	1.403	1.469	1.611
6	1.194	1.265	1.340	1.419	1.501	1.587	1.772
7	1.230	1.316	1.407	1.504	1.606	1.714	1.949
8	1.267	1.369	1.477	1.594	1.718	1.851	2.144
9	1.305	1.423	1.551	1.689	1.838	1.999	2.358
10	1.344	1.480	1.629	1.791	1.967	2.159	2.594
11	1.384	1.539	1.710	1.898	2.105	2.332	2.853
12	1.426	1.601	1.796	2.012	2.252	2.518	3.138
13	1.469	1.665	1.886	2.133	2.410	2.720	3.452
14	1.513	1.732	1.980	2.261	2.579	2.937	3.797
15	1.558	1.801	2.079	2.397	2.759	3.172	4.177
16	1.605	1.873	2.183	2.540	2.952	3.426	4.595
17	1.653	1.948	2.292	2.693	3.159	3.700	5.054
18	1.702	2.026	2.407	2.854	3.380	3.996	5.560
19	1.754	2.107	2.527	3.026	3.617	4.316	6.116
20	1.806	2.191	2.653	3.207	3.870	4.661	6.727
21	1.860	2.279	2.786	3.400	4.141	5.034	7.400
22	1.916	2.370	2.925	3.604	4.430	5.437	8.140
23	1.974	2.465	3.072	3.820	4.741	5.871	8.954
24	2.033	2.563	3.225	4.049	5.072	6.341	9.850
25	2.094	2.666	3.386	4.292	5.427	6.848	10.835

Insert.

of years (n)	3%	4%	5%	6%	7%	8	10%
1	0.9709	0.9615	0.9524	0.9434	0.9346	0....	—
2	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	.. —
3	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7513
4	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.6830
5	0.862.	0.8219	0.7835	0.7473	0.7130	0.6806	0.6209
6	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5645
7	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5132
8	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.4665
9	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4241
10	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.3855
11	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3505
12	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3186
13	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.2897
14	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2633
15	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2394
16	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2176
17	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.1978
18	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.1799
19	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1635
20	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1486
21	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1351
22	0.5219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1228
23	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1117
24	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1015
25	0.4776	0.3751	0.2953	0.2330	0.1842	0.1460	0.0923

Table A-3. [redacted] Capital Recovery Factor

Number of years (n)	Annual interest rate						
	3%	4%	5%	6%	7%	8%	10%
1	1.03000	1.04000	1.05000	1.06000	1.07000	1.08000	1.10000
2	0.52261	0.53020	0.53780	0.54544	0.55309	0.56077	0.57619
3	0.35353	0.36035	0.36721	0.37411	0.38105	0.38803	0.40211
4	0.26903	0.27549	0.28201	0.28859	0.29523	0.30192	0.31547
5	0.21835	0.22463	0.23097	0.23740	0.24389	0.25046	0.26380
6	0.18460	0.19076	0.19702	0.20336	0.20980	0.21632	0.22961
7	0.16051	0.16661	0.17282	0.17914	0.18555	0.19207	0.20541
8	0.14246	0.14853	0.15472	0.16104	0.16747	0.17401	0.18744
9	0.12843	0.13449	0.14069	0.14702	0.15349	0.16008	0.17364
10	0.11723	0.12329	0.12950	0.13587	0.14238	0.14903	0.16275
11	0.10808	0.11415	0.12039	0.12679	0.13336	0.14008	0.15396
12	0.10046	0.10655	0.11283	0.11928	0.12590	0.13270	0.14676
13	0.09403	0.10014	0.10646	0.11296	0.11965	0.12652	0.14078
14	0.08853	0.09467	0.10102	0.10758	0.11434	0.12130	0.13575
15	0.08377	0.08994	0.09634	0.10296	0.10979	0.11683	0.13147
16	0.07961	0.08582	0.09227	0.09895	0.10586	0.11298	0.12782
17	0.07595	0.08220	0.08870	0.09544	0.10243	0.10963	0.12466
18	0.07271	0.07899	0.08555	0.09236	0.09941	0.10670	0.12193
19	0.06981	0.07614	0.08275	0.08962	0.09675	0.10413	0.11955
20	0.06722	0.07358	0.08024	0.08718	0.09439	0.10185	0.11746
21	0.06487	0.07128	0.07800	0.08500	0.09229	0.09983	0.11562
22	0.06275	0.06920	0.07597	0.08305	0.09041	0.09803	0.11401
23	0.06081	0.06731	0.07414	0.08128	0.08871	0.09642	0.11257
24	0.05905	0.06559	0.07247	0.07968	0.08719	0.09498	0.11130
25	0.05743	0.06401	0.07095	0.07823	0.08581	0.09368	0.11017

Table A-4 [redacted] Invest.

Number of years (n)	Annual [redacted]						
	3%	4%	5%	6%	7%	8%	10 %
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2	0.49261	0.49020	0.48780	0.48544	0.48309	0.48077	0.47619
3	0.32353	0.32035	0.31721	0.31411	0.31105	0.30803	0.30211
4	0.23903	0.23549	0.23201	0.22859	0.22523	0.22192	0.21547
5	0.18835	0.18463	0.18097	0.17740	0.17389	0.17046	0.16380
6	0.15460	0.15076	0.14702	0.14336	0.13980	0.13632	0.12961
7	0.13051	0.12661	0.12282	0.11914	0.11555	0.11207	0.10541
8	0.11246	0.10853	0.10472	0.10104	0.09747	0.09401	0.08744
9	0.09843	0.09449	0.09069	0.08702	0.08349	0.08008	0.07364
10	0.08723	0.08329	0.07950	0.07587	0.07238	0.06903	0.06275
11	0.07808	0.07415	0.07039	0.06679	0.06336	0.06008	0.05396
12	0.07046	0.06655	0.06283	0.05928	0.05590	0.05270	0.04676
13	0.06403	0.06014	0.05646	0.05296	0.04965	0.04652	0.04078
14	0.05853	0.05467	0.05102	0.04758	0.04434	0.04130	0.03575
15	0.05377	0.04994	0.04634	0.04296	0.03979	0.03683	0.03147
16	0.04961	0.04582	0.04227	0.03895	0.03586	0.03298	0.02782
17	0.04595	0.04220	0.03870	0.03544	0.03243	0.02963	0.02466
18	0.04271	0.03899	0.03555	0.03236	0.02941	0.02670	0.02193
19	0.03981	0.03614	0.03275	0.02962	0.02675	0.02413	0.01955
20	0.03722	0.03358	0.03024	0.02718	0.02439	0.02185	0.01746
21	0.03487	0.03128	0.02800	0.02500	0.02229	0.01983	0.01562
22	0.03275	0.02920	0.02597	0.02305	0.02041	0.01803	0.01401
23	0.03081	0.02731	0.02414	0.02128	0.01871	0.01642	0.01257
24	0.02905	0.02559	0.02247	0.01968	0.01719	0.01498	0.01130
25	0.02743	0.02401	0.02095	0.01823	0.01581	0.01368	0.01017